

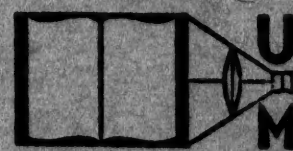
Vol. XVII

No. 6

DISSERTATION ABSTRACTS

*ABSTRACTS OF DISSERTATIONS AND
MONOGRAPHS IN MICROFORM*

UNIVERSITY MICROFILMS
ANN ARBOR, MICHIGAN: 1957



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LITHOPRINTED IN THE UNITED STATES OF AMERICA BY
CUSHING - MALLOY, INC., ANN ARBOR, MICHIGAN, 1957

INTRODUCTION

This year *Dissertation Abstracts* will carry, as the 13th issue of Volume XVII, an index to all doctoral dissertations published in the United States and Canada. This issue will be titled *Index to American Doctoral Dissertations*, and will be a continuation of *Doctoral Dissertations Accepted by American Universities*.¹ The joining of these two reference works makes it possible for librarians to have an integrated bibliographical research tool relating to doctoral dissertations under one cover.

Dissertation Abstracts will continue to provide abstracts of dissertations by recipients of doctoral degrees from graduate schools cooperating with University Microfilms in the publication of complete dissertation texts on microfilm, on Microcards, or as microprint. At the end of each abstract will be found an indication of the number of pages in the original typescript and the Library of Congress card number, for the convenience of scholars and research workers. In some instances *Dissertation Abstracts* will be found to be an adequate substitute for the published dissertations.

The *Index to American Doctoral Dissertations* will be a complete indexed listing of dissertations by students who were granted doctoral degrees during the previous academic year, and including those abstracted in *Dissertation Abstracts*, arranged by degree-granting institutions under appropriate subject headings. An alphabetical author index will be included.

The tabular material which has been an established part of its predecessor volume will be included in full, so arranged that statistical summaries can be maintained with no break in continuity.

It is hoped that those who use *Dissertation Abstracts* will continue to make suggestions for its improvement, as these are vital to its continued life and growth. Several suggestions for changes in the headings used for indexing purposes have been received, and a committee of the Association of Research Libraries is reviewing the indexing system at the present time as a result of these suggestions.

¹Arnold H. Trotter and Marian Harman, (eds.), *Doctoral Dissertations Accepted by American Universities*. (New York: H. W. Wilson Co., 1933-1955.)

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AGRICULTURE

AGRICULTURE, GENERAL

A STUDY OF COBALT IN MICHIGAN SOILS

(Publication No. 21,045)

Costas George Apostolakis, Ph.D.
Michigan State University, 1955

In view of the interest in the cobalt problem from the standpoint of the nutrition of animals in the State of Michigan a study was originated (1) to study spectrographic procedures for the estimation of cobalt in plant and soil material, (2) to evaluate the cobalt content of some surface soils, and (3) to determine its availability to plants under different soil treatments.

A spectrographic procedure involving the preconcentration of cobalt using 8-hydroxyquinoline was developed and found to give very satisfactory results in determining trace amounts of cobalt in plants, soils and their fractions.

The yield of red clover grown in the greenhouse on two soils was not influenced by applications of cobalt sulphate. However, an increase in the cobalt content of clover resulted from increased applications of this cobalt salt to the soil.

Various applications of lime material caused a decrease in the cobalt content of red clover. The highest application of lime resulted in the lowest cobalt content in the plant tissue, especially in the Coloma sand soil. The results obtained with plants grown on the Hillsdale sandy loam were erratic.

Laboratory studies consisted of the determination of the available cobalt of the soils, the total cobalt content of alfalfa grown thereon and the total cobalt content of the soils and their fractions.

The available cobalt content of the soils studied varied from 0.08 to 0.68 parts per million, while the cobalt content of alfalfa grown on them ranged from a minimum of 0.03 to a maximum of 0.24 parts per million. The total cobalt content of the soils ranged from 0.47 to 2.17 parts per million.

No significant correlation was obtained between the cobalt content of the plant and the total or available cobalt content of the soils although in some cases, a direct trend was evident.

As a rule the cobalt content of the various fractions increased as particle size decreased. No significant correlation was obtained when the total cobalt content of the soil was compared to that of the individual sand, silt or clay fractions.

114 pages. \$2.00. Mic 57-1866

THE EXCHANGEABLE AND EXTRACTABLE CATION STATUS OF SOIL AS AFFECTED BY VARIOUS MOISTURE LEVELS DURING INCUBATION

(Publication No. 21,476)

Milford Raynord Heddleson, Ph.D.
The Ohio State University, 1957

A study was conducted to determine the influence of incubation at different moisture levels on exchangeable or extractable cations and on acidity of soils. The soils used were Miami silt loam and Mahoning silt loam, which are gray Brown Podzolic soils, Brookston silty clay loam, a Humic gley, and 7A3, a Sol Brun Acide-Brown Podzolic intergrade soil. Samples from both the A and the B horizons of each soil were studied.

Soils normally are collected under variable moisture conditions in the field. They are air-dried and often stored for a period of time before chemical analyses are made. The purpose of the study was to compare the amounts of cations extractable from air-dry soils with those extracted from soils maintained in moist or saturated conditions for a period of time.

Determinations were first made on air-dry samples, and the data obtained were used as a basis for comparison. Samples of the soils were incubated at approximate field capacity and under saturated conditions for several weeks and then redried. Chemical determinations were made at frequent intervals in order to observe changes with time which took place in the exchangeable cation status of the soils.

Exchangeable calcium, potassium, magnesium, and manganese were extracted with neutral, normal ammonium acetate. Soil reaction and exchange acidity were determined, the latter by using buffered barium chloride at pH 8.1. Extractable manganese, aluminum, and iron were displaced with normal ammonium acetate buffered at pH 4.8. Calcium, potassium, and magnesium were measured by use of a flame photometer, while manganese, aluminum, and iron were measured colorimetrically. Determination of exchangeable calcium, potassium, and magnesium were made at approximately two-week intervals. Extractable iron, aluminum, and manganese were measured more frequently: daily at the beginning of the incubation period, and at intervals of several days in the later stages.

It was found that moisture condition did not have any appreciable effect on the amount of exchangeable calcium and magnesium, and only moderate changes were noted for potassium. Extractable aluminum was found to decrease in soils incubated at either field capacity or saturated moisture, the decrease being greater in the latter. Exchangeable acidity was shown to decrease, and pH to increase, when soils were incubated under saturated conditions. There was an appreciable increase in exchangeable manganese when topsoils were incubated under saturated conditions. Except for the Brookston B horizon, subsoils did not show an increase in exchangeable manganese when saturated.

The amount of extractable iron was decreased by incubating soils at field capacity moisture level. A decrease in extractable iron was also shown when B horizons were saturated. When A horizons were saturated, large quantities of iron became extractable. This iron probably was released from the free iron oxides of the soil. The release of reduced iron did not have an appreciable influence on the exchange capacity of the soil.

The study indicated that the exchangeable cation content of soils analyzed after air-drying was not appreciably different from that which might have been found under natural field conditions except for extractable iron and manganese from saturated topsoils. Soils which are waterlogged under natural conditions would be expected to contain large quantities of extractable manganese and reduced iron. This condition would not be indicated by analyses after the soils were air-dried in the laboratory.

86 pages. \$2.00. Mic 57-1867

AN ECONOMIC ANALYSIS OF TRADING IN EGG FUTURES, 1934-54

(Publication No. 20,077)

Joseph W. Koudele, Ph.D.
Michigan State University, 1956

Objectives of this economic study of trading in egg futures on the Chicago Mercantile Exchange during 1934-54 were: to determine the characteristics of trading and its present significance in egg marketing; to show the nature and significance of price relationships between cash (fresh) eggs and refrigerator egg futures, and among futures; to examine changes in the futures market in relation to important economic trends in the production and marketing of eggs from prewar (1934-41) to postwar (1946-54) years; and to show the influence of certain internal market forces upon prices of egg futures.

Major sources of statistical data included: Commodity Futures Statistics, an annual publication of the Commodity Exchange Authority; daily records of the Authority on volume of trading, open contracts, and prices of egg futures; and the Dairy-Produce Year Book (and successor year books) for prices of cash eggs on the Chicago Egg Market. Different statistical methods appropriate to the analysis were used.

Trade use of the market, as shown by levels of open contracts, increased moderately while volume of trading increased sharply reflecting considerable speculative activity during postwar years. But speculative limits on trading established in October 1951, while not impairing the hedging function, have greatly lessened the influence of large-scale speculative activity upon price fluctuations.

In their general seasonal relationships, prices of cash eggs were below futures during the into-storage season reflecting carrying charges for storing eggs and were above futures during the out-of-storage season. The cash-future price spread during the storing season was especially significant in influencing decisions relating to storage operations. The spread also determined the effectiveness of hedging.

A moderate, direct association was found between daily

volume of trading and futures price range, with greater price variability at higher ranges of trading volume.

Significant changes occurred from prewar to postwar in the egg futures market and largely reflected the influence of the more even seasonal pattern of egg production and the decline in shell egg storage. The fact that stocks deliverable on futures contracts declined relative to open commitments was an important factor predisposing the market to manipulative situations in certain postwar years. Refrigerator (storage) eggs were discounted more heavily relative to fresh eggs in the out-of-storage season during the postwar period. Also a smaller ratio of deliveries indicated the market had reached a stage of maturity closely approximating that of the grains and cotton.

A judicial decision rendered in proceedings involving cornering and price manipulation in the egg futures market has strengthened the Government's position in dealing with such trading abuses in the future.

Major contributions in the marketing of eggs rendered by egg-futures trading were hedging and price discovery. The futures market exerted an important influence on the structure of egg prices and price quotations were used widely by the trade. The proportion of shell egg stocks hedged during postwar years ranged from 13 to 51 percent and reflected dependence on the market for this service whenever the need arose.

Certain adjustments in trading rules in line with changing economic conditions in the industry as well as continued, close supervision of trading are needed if futures trading in eggs is to make its maximum contributions.

337 pages. \$4.35. Mic 57-2286

RELATIONSHIPS OF MERCHANDISING PRACTICES AND OTHER FACTORS TO THE SALES OF GREENHOUSE TOMATOES IN RETAIL FOOD STORES

(Publication No. 21,484)

Theodore William Leed, Ph.D.
The Ohio State University, 1956

Ohio is the leading state in the Union in the production of greenhouse tomatoes. The wholesale value of this crop in Ohio was nearly seven million dollars in 1949. Shipped-in, repacked or tubed, and vine-ripened tomatoes have become increasingly competitive with greenhouse tomatoes as production and marketing practices have improved.

The purpose of the study was to show how financial returns to greenhouse tomato growers can be increased by improved retail and wholesale merchandising practices in the sale of greenhouse tomatoes.

The retail merchandising phase of the study included two controlled experiments to determine the effects of various methods of display and of two methods of in-store sales promotion on the rate of sales of greenhouse tomatoes. Spoilage losses of greenhouse and tubed tomatoes were also studied.

The latin square experimental design was used to test the effects of five methods of display upon the sales of greenhouse tomatoes in retail food stores during the periods November 2-December 19, 1953, and June 1-26, 1954. The methods of display tested were bulk single layer, bulk

in baskets, bulk single layer in combination with cellophane bags, cellophane bags, and polyethylene bags.

Three groups of four stores each were used to test the effects of two methods of in-store promotion on the sales of greenhouse tomatoes during the period April 26-June 26, 1954. The methods of promotion tested were (1) lettered signs above the displays which identified the product as greenhouse tomatoes and (2) a "salad bowl" exhibited by a demonstrator who distributed free slices of greenhouse tomatoes. The lettered signs were tested in four stores for a five-week period. The salad bowls were tested in four stores for two days.

Analysis of variance indicated that there were no significant differences in greenhouse tomato sales or in the ratios of greenhouse to tubed tomato sales attributable to methods of display. The greatest amount of variance in greenhouse tomato sales occurred among stores. Sales of greenhouse tomatoes were usually greatest when the tomatoes were displayed in bulk single layer in combination with cellophane bags.

The lettered signs did not increase greenhouse tomato sales in any of the stores. The salad bowl promotion increased sales significantly in three of four stores where it was tested. The extent of the increase was relatively greater and more prolonged in the store that had previously done the weakest job of merchandising greenhouse tomatoes. The ratio of greenhouse to tubed tomato sales was considerably greater in the group of stores that had the salad bowl promotion than in the remaining stores.

Spoilage loss during the fall season amounted to five per cent of sales for greenhouse tomatoes and nearly twelve per cent for tubed tomatoes. During the spring season, spoilage loss amounted to about three per cent of greenhouse tomato sales and six per cent of tubed tomato sales.

Wholesale supply and price data from the Cincinnati, Ohio market for 1948-1953 were analyzed by regression analysis to determine the importance of various factors in establishing the price of greenhouse tomatoes. The price of tubed tomatoes explained more of the variation in greenhouse tomato prices than did the supply of greenhouse tomatoes. The price of tubed tomatoes together with the supply of greenhouse tomatoes explained more than one-half of the variation in greenhouse tomato prices for the fall crops and more than 70 per cent for the spring crops, 1948-1953. The analysis indicated that the wholesale demand for greenhouse tomatoes was highly elastic.

169 pages. \$2.25. Mic 57-1868

STUDIES ON NECROSIS IN THE INFECTION OF KHAPLI EMMER BY THE STEM RUST FUNGUS, PUCCINIA GRAMINIS VAR. TRITICI

(Publication No. 21,254)

Charles Robert Olien, Ph.D.
University of Minnesota, 1957

Advisers: Helen Hart and John B. Rowell

The necrotic fleck symptom of wheat stem rust, which results from the disease processes of certain host-race combinations, is associated with a high degree of disease

resistance. The necrosis which develops rapidly after flecking retards extension of the fungus through the host and restricts rust sporulation. A study of the cause of necrosis was attempted since information concerning a natural means of resistance might be useful in disease control.

An ideal method of studying substances associated with symptom expression might involve separating these substances from their site of origin soon after their formation, in such a manner that the nature of the disease process is not altered by influence of the method of separation and that the substance is not altered by reaction with other constituents of the environment. The drastic physiological effects of a toxin would be dependent upon its functional groups which might be ionized or capable of adsorbing ions causing the toxin to be charged, and it might be possible to establish a weak electric field in the host which would not interfere greatly with the disease processes but yet be strong enough to displace such a charged substance. Electrophoretic migration of a toxin within living tissue would be preferable to attempting the separation of such a reactive substance from the complex of materials found in a tissue extract.

In preliminary experiments, it was found that the leaf tissue could endure approximately 0.8 coulombs before any injury to the leaf. This treatment is equivalent to an electrical impetus of approximately four times that normally used in regular electrophoresis equipment. Results from other preliminary experiments, involving the migration of silver through the host tissue, indicated that introduced ions migrate preferentially through the mesophyll tissue and in a uniform pattern.

The combination of Khapli emmer and stem rust race 56 was chosen for study since it resulted in a large necrotic lesion; the necrosis initially becoming evident about one week after inoculation. Various electrical treatments were applied to the diseased tissue at all stages of disease development. Displacement of the necrotic area from the region of mycelial development occurred: when good development of the fungus occurred during the incubation period, when the electrical treatment was started just before any necrotic tissue became evident, and when the intensity of the electrical treatment was balanced with the rate of disease development. Further experimental work demonstrated that there was a divergence of the electric field from distinctly necrotic lesions preventing the displacement of the necrotic area from the region of mycelial development in older necrotic lesions.

The experimental results indicate that a single, negatively charged substance is responsible for the necrosis of the necrotic fleck symptom of wheat stem rust.

63 pages. \$2.00. Mic 57-1869

THE ACREAGE RESPONSE OF MICHIGAN FARMERS IN EAST CENTRAL COUNTIES TO THE RELATIVE PRICES OF SUGAR BEETS AND FIELD BEANS

(Publication No. 20,083)

Roger Phillippe Perreault, Ph.D.
Michigan State University, 1956

In small homogeneous areas where specialized conditions prevail and cash crops alternatives are found, farmers are expected to have a high acreage response to the relative prices of crops competing for the use of land and other resources. However, there are cases where risk and uncertainty limit the producer's response to relative price changes.

Such is the case in East Central Michigan--a leading cash field crops production area in Michigan. Despite the fact that sugar beet prices have been more stable and that net income per acre from that crop higher than for field beans, sugar beet acreage is still considerably smaller than that for field beans.

This situation encouraged the testing of the farmers' response to the relative prices of sugar beets and field beans, and the analysis of the effects of risk and uncertainty on the principal economic and noneconomic factors likely to affect this response.

Considerable emphasis was placed on the agronomic features, institutional framework, yield variations, pricing and marketing arrangements, cost structure and Government programs affecting these crops, and on their over-all effects on acreage response.

A theoretical model involving a profit maximization and a utility function was built under the assumption that the total acreage of these crops has been constant from year to year. It was postulated that farmers diversify because as they increase the acreage of the more favorable crop the risk element increases.

This model was transformed because the total acreage was not constant and some of the basic data were not available. A recursive model containing a field bean and sugar beet equation was developed. The planted acreage of sugar beets was treated as a function of the intended acreage of field beans, the price ratio of sugar beets and field beans during the preceding year, the price ratio of sugar beets to livestock products during the preceding year, the cost of fall beet labor per acre adjusted by the percentage of the acreage mechanically harvested, and a dummy variable representing weather conditions at planting time. The basic data used were county acreage estimates and weighted average seasonal prices. The period under study was 1928-1954 with the years 1931 and 1941 in addition to the war years omitted.

These factors explained about 60 per cent of the variation in the planted acreage of sugar beets. Except for the labor variable all signs were as expected. Only the price ratio of sugar beets to field beans was found significant within the .05 per cent level by the t test.

The high degree of uncertainty involved in the production of sugar beets has an important effect in limiting the expansion of sugar beets. The uncertainty includes: an uncertain labor supply, the signing of a contract, the belatedness of sugar beet payments, a variable sugar content, complex pricing and marketing methods, the lack of cash reserves, and the high technical skills required in the production of sugar beets.

Other hypotheses were tested. The acreage of wheat, the yields of sugar beets and field beans, the abandoned acreage of sugar beets, etc. respectively were not found to affect significantly the sugar beet acreage response.

189 pages. \$2.50. Mic 57-1870

ECONOMIC ANALYSIS OF THE USE OF LABOR AND EQUIPMENT IN EGG PRODUCTION ON ILLINOIS FARMS

(Publication No. 20,892)

Roy Neuman Van Arsdall, Ph.D.
University of Illinois, 1957

Rapid advances in mechanization, refinements in technology and shifts in price relationships between labor and mechanical equipment have increased the disadvantage for the producer with the small laying flock. The typical Illinois flock averages only 140 hens and labor requirements are high, but the trend is toward fewer and larger flocks and a need for more efficient use of labor and equipment.

Information relating to the use of labor, equipment, housing and work methods in egg production was obtained by personal interview from 230 Illinois farmers with laying flocks ranging from 200 to 10,000 hens. During 1955 and 1956 detailed operation studies were made of 30 litter house systems and five farms with caged layers. The most efficient producers in this group had reduced routine chores to 30 to 40 hours per 100 hens per year compared with the estimated 190 hours for the average Illinois flock.

Farms studied were located in the northeastern, east central and south central sections of the state. They included all of the major methods of handling chores for laying flocks in Illinois.

The time and travel study technique and cost analysis were used as basic tools for collecting and analyzing data. An analysis was made of the influence of size of flock, practices, equipment and arrangement of facilities on labor requirements. Physical standards and costs were estimated for the major methods of accomplishing daily routine chores in egg production. The most economical methods of accomplishing poultry chores were calculated for different flock sizes and for different levels of availability of labor and capital. The over-all results of the study were translated into improved layouts of equipment and buildings, and into labor-saving work methods to satisfy the need for practical solutions at the farm level.

Special attention was given to the general application of the work simplification technique in solving problems of livestock chore work with particular reference to procedures followed in the study of egg production.

Either multiple- or single-story houses were suitable for housing laying hens, but single-story buildings were best adapted to the general type of farming in Illinois. Old livestock barns had been economically converted into multiple-story laying houses on some farms.

The chore of distributing feed ranged from one to 27 hours per 100 hens per year. Major variables were type of feeder, location of feed storage, number of daily feedings and size of flock. Labor and equipment costs were lower for handling self-feeders than trough feeders for

all flock sizes. With 1955 market wage and interest rates mechanical feeders were more economical than trough feeders with flocks of 700 hens and more economical self-feeders with flocks of 1,000 hens.

Carrying water by hand averaged 27 hours per 100 hens per year. Automatic water systems required less than one hour of labor annually and were more economical than hand watering for flocks of 250 hens, the smallest included in the study.

Gathering eggs required 15 to 28 hours per 100 hens per year, depending on size of flock. Type and location of nests had little effect on labor inputs. Frequency of gathering affected labor requirements and number of eggs broken in the nests. A minimum of three daily gatherings was most economical with regular nests. Management of nesting facilities and type of nest were important in reducing floor eggs.

Cleaning and packaging eggs by hand accounted for one-half to three-fourths of total chore time. Annual labor inputs averaged 45 hours per 100 hens. Mechanical washing of eggs reduced annual chore time by 25 to 30 hours per 100 hens and was more economical than hand methods for flocks of 300 or more hens. Mechanical grading was less costly than hand grading with flocks of 750 or more hens.

Keeping hens in individual wire cages was a new practice on Illinois farms. More labor and a higher investment for equipment were required with cages than with similarly mechanized litter house systems. Whether the advantages of cages will outweigh the disadvantages will require a more thorough study of the system under midwestern conditions.

253 pages. \$3.30. Mic 57-1871

AGRICULTURE, ANIMAL CULTURE

REPRODUCTION STUDIES IN DAIRY CATTLE:

I: POSTPARTUM ESTRUS AND INVOLUTION OF THE UTERUS. II: SURVIVAL OF SPERMATOZOA AFTER FREEZING AND THAWING.

(Publication No. 18,383)

Natwarlal Chandulal Buch, Ph.D.
The University of Wisconsin, 1956

Supervisors: Professor Lester E. Casida and
Associate Professor Wilber J. Tyler

I - POSTPARTUM ESTRUS AND INVOLUTION OF THE UTERUS IN AN EXPERIMENTAL HERD OF HOLSTEIN-FRIESIAN COWS

Satisfactory breeding efficiency in cows can be maintained by maintaining regular calving intervals of desirable length. This depends on the cows being fertile when rebred at suitable postpartum interval. Short intervals from calving to rebreeding do not appear to give high conception rates which may possibly be due to incomplete involution of the uterus at the time when cows are bred. In order to know the potential relationship of the intervals to first heat and involution of the uterus to the time of

rebreeding a study of the intervals from parturition to involution of the uterus and from parturition to first heat was made respectively on 252 and 322 normal calvings in a Holstein-Friesian herd. Heat checks were made by the estrual behavior of the cows and complete involution of the uterus was judged by manual palpations. The average interval to involution was 47 days, and to first heat was 33 days. The difference in the involution interval between primiparous (42 days) and pluriparous (50 days) cows was highly significant, and significant differences were observed among seasons, being shortest in the summer and autumn. Cows calving during summer tended to come in heat earlier than those calving in the other seasons, whereas those calving during winter had the longest intervals from parturition to first heat. Examination was made of the data on cows that had come into heat by end of different intervals of time postpartum to determine the proportions of such cows whose uteri were involuted. Of all cows in heat after an interval of 30 days, 6% had their uteri involuted, 44% had them involuted at 45 days, 75% at 60 days, 87% at 75 days, 96% at 90 days, 99% at 105 days, and approximately 100% at 120 days. A slight association within the parity season groups ($r = 0.147$; $P = 0.05$) was found between intervals to first heat and to involution of the uterus. A study of 71 abnormal calvings indicated a little longer interval (5 days) to involution than for cows calving normally. The primiparous cows in this group also involuted earlier than pluriparous cows.

II - BULL AND LINE DIFFERENCES IN THE SURVIVAL OF SPERMATOZOA AFTER FREEZING AND THAWING

Various studies on different factors such as influence of various levels of egg-yolk, sodium citrate, glycerol as well as various temperature aspects of freezing and thawing and equilibration time have been made to study the survivability of bull spermatozoa at sub-zero temperatures. Whether or not any genetic difference exists in the survivability of spermatozoa before and after freezing and thawing has not been demonstrated. This study compares the percentage survivability of spermatozoa between bulls, between different inbred lines and between different periods before and after freezing for 12 Holstein-Friesian bulls representing six inbred lines under uniform conditions.

A marked difference was observed between bulls in the ability of their spermatozoa to withstand freezing although there were no significant differences prior to freezing. No line differences were observed at any of the pre- or postfreezing periods and as such this study does not indicate any evidence of genetic difference in the survival of spermatozoa before or after freezing. Although some bulls show an unusual change in the survivability of spermatozoa after freezing, the trend of the majority of the bulls suggests that in most cases their performance at 12 weeks can be predicted immediately after freezing. A highly significant decline in the percent survival of spermatozoa was observed from period to period. The rate of decline was the highest during the first two weeks after freezing.

32 pages. \$2.00. Mic 57-1872

THE EFFECTS OF DIETHYLSTILBESTROL
ADMINISTERED BY IMPLANTATION AND BY
INGESTION ON GROWTH, FATTENING AND
CARCASS CHARACTERISTICS OF BEEF STEERS

(Publication No. 21,243)

Don LaDoyt Good, Ph.D.
University of Minnesota, 1957

Two trials with 24 individually fed long yearling good to choice Hereford steers were used to study the effects of diethylstilbestrol administered by implantation and by ingestion on growth, fattening, and carcass characteristics of beef steers. The cattle were divided by weight into three groups of four steers each for both trials. Four steers served as controls, four were implanted at the base of the ear with 84 mg. of stilbestrol and four were fed 10 mg. of stilbestrol per head daily.

The feeding period for each trial was 117 days and the ration consisted of three parts by weight of yellow corn, one part by weight of chopped alfalfa hay and one-half pound soybean oil meal per head daily. A mineral mixture of equal parts steamed bone meal and salt was provided free choice and fresh water was available at all times.

Stilbestrol ingested or implanted increased appetite and the gains were greater and more economical. The controls gained 2.71 pounds per head daily, those fed stilbestrol 2.97 pounds and the implanted cattle 3.28 pounds per head daily. The least efficient were the controls which required 86 pounds more feed than the implanted group and 107 pounds more than the stilbestrol fed group to produce 100 pounds of gain.

This study showed that both feeding and implanting stilbestrol caused side effects that may be potentially harmful, but in these trials the effects were not sufficiently strong to affect significantly the performance of the steers. The side effects were more pronounced in the implanted group.

Teat length and the size of the sex organs were increased significantly by feeding and by implanting stilbestrol. The diameter and length of the penis was increased and the bulbourethra and prostate glands showed hypertrophy as the result of stilbestrol treatment. The bulbocavernosus and retractor penis muscles were also enlarged as the result of the hormone treatment.

Stilbestrol administered by ingestion or by implantation did not significantly affect dressing percentage, shrink to market, carcass grade, cooler shrink, moisture content of fat or lean, cooking quality or measurements of the right metacarpus.

Mechanical separation of fat, lean, and bone revealed that stilbestrol fed directly significantly increased the percentage of lean meat in the carcass and decreased the percentage of fat. The average percentage of nitrogen content of the eye muscle was significantly increased by the stilbestrol implants.

The only carcass measurement affected significantly by stilbestrol treatment was width of round, which was increased.

In this study there was not much difference between results obtained by feeding or by implanting stilbestrol. Both treatments increased the live weight gains of the steers.

It is possible that hypertrophy of the genital organs of stilbestrol treated cattle may complement the onset of

urinary calculi because of partial occlusion of the urethra, causing difficult passage of calculi particles which, under normal conditions, might pass freely.

127 pages. \$2.00. Mic 57-1873

THE CYTOPATHOGENESIS OF VESICULAR
STOMATITIS VIRUS INFECTION IN CATTLE

(Publication No. 21,228)

William Eugene Ribelin, Ph.D.
The University of Wisconsin, 1957

Supervisor: Professor S. H. McNutt

Histologic studies have been made previously of tissues infected with vesicular stomatitis but information correlating viral activity and the resultant cellular and tissue changes is not available. In the present study efforts were made to correlate viral infection, multiplication, and liberation with histologically recognizable changes in infected epithelium. Histologic studies were made of infected bovine tongue epithelium. Phase microscope studies were performed using vesicular stomatitis infected calf skin grown and observed in tissue culture. Growth rates and times of virus liberation were determined in cultures of infected calf skin. The relative abilities to support multiplication of virus were determined by comparative titrations using calf skin grown in tissue culture, embryonating hens eggs, and guinea pig foot-pads as the means of titrating aliquots of a common virus pool.

Histologic study of infected calf tongue showed that the viral infection begins in the stratum spinosum, later extending down into the basal layer and up into the stratum granulosum. Within this tissue the effects of the virus are manifested chiefly in the cytoplasm of infected cells. In infected cells shrinkage of cytoplasm occurs concomitantly with increased prominence of the intercellular bridges and the appearance of edema fluid between the cells. Cytoplasmic shrinkage continues, the cell processes withdraw completely until the cell consists of the apparently unaltered nucleus enclosed by a rim of granular cytoplasm. Nuclear shrinkage and pyknosis then occur and the cell loses all extracellular attachments to float free in the accumulating vesicle fluid. The entire process occurs in less than 24 hours.

Studies of viral multiplication in tissue cultures derived from fetal bovine skin revealed that release of virus from infected cells began about the third hour following infection of the cell. A subsequent transient drop occurred which was followed thereafter by a regular and progressive increase in the amount of virus released.

Phase microscope studies were made of virus-infected fetal bovine skin cells grown in tissue culture. Basically the same changes were seen as those encountered in the infected host. About the second hour following infection contraction of the cytoplasm of affected cells with continued extension of the cytoplasmic processes was observed. This contraction in tissue culture indicated that the same process occurring in the host was a direct manifestation of action of the virus and was not due merely to physical pressure exerted by the vesicle fluid. By the fourth hour following infection globular swellings could be detected on

the normally filamentous mitochondria. Cytoplasmic retraction continued, accompanied by retraction of the cytoplasmic processes, and by the sixth hour mitochondria were no longer recognizable. Shrinkage of the nucleus began at this time and proceeded although at a slower rate than that of the cytoplasm. The nucleus, however, retained its distinct membrane and the chromatin remained recognizable therein. The process was completed by the tenth to twelfth hour at which time the cell floated free as a small spherical mass of granular cytoplasm enclosing a minute, shrunken residual nucleus. The viability of epithelial cells infected with vesicular stomatitis virus is therefore less than 10 to 12 hours.

Titration of virus in epidermal tissue cultures, embryonating hens eggs, and guinea pig foot-pads revealed that cultures derived from fetal bovine skin were highly susceptible to vesicular stomatitis. Their susceptibility did not vary significantly from that of the embryonating egg. Guinea pig foot-pads were of a much lower order of susceptibility. The titers were approximately 2 logs of virus lower.

101 pages. \$2.00. Mic 57-1874

AGRICULTURE, FORESTRY AND WILDLIFE

FOREST SUCCESSION ON THE WELL-DRAINED SOIL IN THE HIGGINS LAKE AREA OF MICHIGAN

(Publication No. 21,050)

Kim Kwong Ching, Ph.D.
Michigan State University, 1954

The upland forest of Higgins Lake area were studied in an attempt to set the pattern of secondary succession on this vast cut over land. Quantitative data were collected from five different vegetational covers - grassland, oak, aspen, jack pine, and conifer-hardwood types, by the quadrat method of sampling. Stands for studying were carefully selected so that (1) they represented natural forests of adequate size; (2) they were free from disturbances in the forms of fire, grazing or excessive cutting; and (3) they were on upland land forms on which run-off water never accumulated.

In the introduction, the place of forest ecology is briefly outlined. The basic information of original and present forest cover were also discussed. Sections following were devoted to analysis of the environmental factors listed as climatic, edaphic, and biotic. Comparisons between the composition of different soil types and profiles were subjected to analysis. Further work dealt with the development of plant communities and their interrelationship with various soil types and the influence of environmental factors on these different vegetational covers.

Through statistical studies, the following facts have been established: (1) evaporation increased rather uniformly with increased temperature and presents a more definite expression on different forest cover types. (2) the forest soils of most of the studied stands are strongly acid in the upper portions of the profile, especially the A layer. (3) in the presence of a sufficient supply of available nutrients, pH of soils is of minor importance to growth of plants

in the studied stands. (4) the moisture content of soil in the field varies according to vegetation types on different dates, but not at the six and eighteen inch depths. (5) the covering vegetation do not influence the soil organic matter content in the six sample plots. (6) soil temperatures are significantly different under various plant communities with the grassland type having a definite higher reading. (7) among all the factors which fall in the biotic group, destructive logging and fires are largely responsible for the present distribution of plant growth.

It was the opinion of the writer that the forest successional trend on this cutover land will progress in the following manners: the closed canopy of an aspen or oak stand will give place to a higher genetic type, the most frequent ones are pines on the sandy upland, whereas on the better soils, the invading species would be the beech, sugar maple and yellow birch predominantly. Under the present prevailing climatic condition, on the more xeric habitat with decreasing soil moisture, a red or white pine stage may be reached before the arrival of the formation of the northeastern coniferous climax. On more hydric sites, the conifer-hardwood type is often succeeded by the northeastern deciduous forest climax.

159 pages. \$2.10. Mic 57-1875

THE EFFECTS OF A COMPLETE CUTTING OF FOREST VEGETATION AND SUBSEQUENT ANNUAL CUTTING OF REGROWTH UPON SOME PEDOLOGIC AND HYDROLOGIC CHARACTERISTICS OF A WATERSHED IN THE SOUTHERN APPALACHIANS

(Publication No. 21,056)

Forrest Dean Freeland, Jr., Ph.D.
Michigan State University, 1956

This dissertation is a basic research study of watershed hydrology. The objectives of the problem were primarily to determine the effects on water yields by the removal of a deciduous forest in the superhumid region of the Southern Appalachians and the effects of this removal upon the ideal hydrologic condition of the natural forest soil.

After a four-year period of standardization of two adjacent forested watersheds on the Coweeta Hydrologic Laboratory, the forest vegetation was cut on one watershed. The slash was lopped and scattered and nothing was removed from the drainage area. No roads or skid trails were made and maximum precaution was taken to perpetuate the former ideal condition of the forest soil. Each year thereafter all regrowth was cut and left.

In order to study the effects of treatment upon the soils an intensive soil survey of the two watersheds was made and comparable index stations over the two areas were located for sampling for the pedologic studies of treatment effects. V-notch weirs were constructed at the drainage exits of the two watersheds before the period of standardization in order to measure the streamflow characteristics. Weather stations and rain gage stations were established on and near the two watersheds to measure precipitation and other important climatic factors. Keeping one watershed in its former natural forested state after the period of standardization furnished the control watershed approach to the hydrologic studies of the treatment effects.

The soils over the two areas possessed a high degree of uniformity. However, field and laboratory analyses indicated possible changes in the soil taking place due to treatment. The percentage of the large waterstable aggregates in the surface soil layers was found to be lower for the treated watershed. Also, laboratory tests revealed a lower degree of water stability for the large aggregates of the surface soil layers on the treated watershed. The amount of unincorporated humus lying on the soil surface was found to be much less on the treated watershed and the rate of decomposition appeared to be accelerated. A dry clod analysis, volume weight and porosity tests, a permeability test, and field capacity and moisture equivalent tests failed to reveal any trends of differences in these characteristics as yet. The soil moisture content study during the growing season did not show any large differences on the treated watershed in soil moisture from that of the control. Air temperatures and soil temperatures increased due to treatment.

The increase in water yield from the treated watershed was considerable. This increase is most pronounced in the late summer and early fall, when the increase amounts to almost one-hundred percent over non-treatment stream-flow. Minimum flows were raised but high flows were relatively unaffected. Storm peaks were raised slightly. There were no significant changes affected in storm runoff nor water quality. The groundwater depletion curve for the growing season was raised appreciably.

192 pages. \$2.50. Mic 57-1876

**SOME EARLY EFFECTS OF PRESCRIBED BURNING
ON THE SOIL, FOREST FLOOR, AND VEGETATION
IN THE LOBLOLLY-SHORTLEAF PINE FOREST OF
THE UPPER COASTAL PLAIN OF ALABAMA**

(Publication No. 21,063)

Earl Joseph Hodgkins, Ph.D.
Michigan State University, 1956

The study involved the testing of two burning treatments and a hardwood poisoning treatment for effects on soil, forest floor, and vegetation properties in the Upper Coastal Plain region of Alabama. The work was done at the Fayette Experiment Forest, a branch of the Alabama Polytechnic Institute located about 60 miles west of the city of Birmingham. The topography is strongly hilly. The soils are typical upland red and yellow podzolic soils with sandy loam or loamy sand topsoils and sandy clay loam to heavy clay subsoils. The experimental plots were located on old-field areas, many of which had suffered moderate to severe sheet and gully erosion under past cultivation. The vegetative cover consisted of open to dense stands of loblolly pine (*Pinus taeda* L.) and shortleaf pine (*Pinus echinata* Mill.) with variable amounts of hardwood, shrub, vine, grass, and forb species being present as subordinate vegetation.

The burning treatments consisted of August burning, applied in 1951 and in 1954, and January burning, applied in 1952 and in 1955, with suitable check plots being protected from fire. The hardwood poisoning treatment, applied in the spring of 1952, was superimposed on the burning treatments by splitting each main plot into a poisoned

and a nonpoisoned subplot; the treatment consisted of killing with animonium sulfamate an average of 6.23 square feet of basal area per acre in hardwoods over 3 inches in diameter breast high. All treatments were applied on ridges and on slopes. There were 6 replications, 36 main plots, and 72 subplots. Measurements were made and samples were taken in the winter and spring of 1953-54 previous to the second burnings, and again in the late winter and spring of 1955 subsequent to the second burnings.

Burnings were applied on clear days within a few days after substantial rains. The 1951-52 burnings, having 10 years of fuel accumulation, were hotter and caused greater changes than the 1954-55 repeat burnings. The August burnings reduced the forest floor more than the January burnings, and the second August burnings left a dangerously thin residual floor on some plots; however, normal autumn leaf fall apparently soon gave adequate protection against damage to the mineral topsoil from raindrop impact. Generally the loss of nitrogen, potassium, calcium, and phosphorous from the forest floor was in direct proportion to loss of the forest floor itself.

Burning raised the pH of the top 3 inches of mineral soil and added more potassium and calcium to it than the forest floor had lost. The gains were presumed to have come from live vegetation killed by the fires. Available phosphate was increased, but only the repeat burnings appeared to have contributed the additions. Because the soils were extremely low in available phosphate, it was deduced that roots had absorbed additions made available by the 1951-52 burnings during the interval between the burnings and the measurements in 1953-54. Burning caused no change in total soil nitrogen or in soil organic matter.

Burning produced no effects on total porosity, macro-porosity, and micro-porosity of the top 3 inches of mineral soil. There were no significant differences in infiltration rates which were measured only once, in 1955. This may have been due however to the impossibility of statistically removing the strong effects on this factor of past erosion.

Legumes, composites, and euphorbs increased in density of cover in the first growing season after burning, but probably went back to normal thereafter. By the middle of the third growing season, shrubs and vines increased, with January burning showing more increase than August burning. Hardwood cover 6 feet high and under was reduced by burning but was back to normal in the third growing season. Only August burning significantly reduced the cover of all vegetation more than 6 feet high. Grass cover may have been reduced the first season after burning, but subsequently it varied inversely with the total cover of trees, shrubs, and vines.

The only effect of hardwood poisoning seemed to be an increase of soil nitrogen and organic matter on ridges.

It was concluded tentatively that prescribed burning can be applied in the Upper Coastal Plain region of Alabama without significant harm to the soil. More refined experiments are needed to determine which vegetational types at what minimum densities can be burned frequently enough for effective hardwood control without exposing the topsoil to physical deterioration. Nitrogen and organic matter levels of the mineral soil must be checked in the future to verify the assumption that herbaceous vegetation stimulated by burning will replace losses from the forest floor.

182 pages. \$2.40. Mic 57-1877

THE ANATOMICAL AND PHYSIOLOGICAL EFFECTS
OF CHLOROPHENOXYACETIC ACID DERIVATIVES
ON TREMBLING ASPEN (*POPULUS TREMULOIDES*
MICHX.) WITH SPECIAL REFERENCE TO THE
APPLICATION OF SUCH CHEMICALS AS
DEBARKING AGENTS

(Publication No. 21,259)

Cherng-jiann Shiue, Ph.D.
University of Minnesota, 1957

Adviser: Randolph M. Brown

Chemical debarking after further research holds promise as a practical and efficient industrial process. Butoxyl ethanol esters of 2,4-di- and 2,4,5-trichlorophenoxyacetic acid were tested in 1955 and 1956 as aspen-debarking agents at the Cloquet Experimental Forest, University of Minnesota. Aspen trees were sprayed at the base or breast height on different dates during the growing season. Treated and untreated trees were cut in the fall and spring and tested with Wilcox's peelability-testing tool to determine the effectiveness of these chemicals as debarking agents. To check the tool reliability, portable-drum debarking was carried out at the Experimental Forest and commercial-drum debarking at the Northwest Paper Company. Laboratory investigations to determine absorption and translocation of 2,4,5-T, the moisture content, and the physiological and anatomical changes in treated trees were conducted to explain the results from the field experiments. How chemical debarking affected the vegetative reproduction of aspen was studied by testing the suckering capacity of root cuttings from treated trees.

Percentage of bark removed by drum debarking was found to be closely related to the force required to remove the bark as measured by the Wilcox tool. Highly significant correlation coefficients between these variables were obtained for both portable and commercial drum debarkers.

Peeling resistance of aspen cut in the dormant season was significantly reduced by 2,4,5-T. Breast high spraying was more effective than spraying at the tree base. June treatments resulted in least peeling resistance. Bolts from trees sprayed at breast height in June could be satisfactorily hand peeled and debarked in a drum debarker even though cut in the dormant season when untreated trees can not be cleanly and economically peeled.

Treated trees cut in August and September had a higher moisture content than untreated trees cut at this time. The moisture content of untreated and treated trees was not significantly different when cut in October or the following spring.

When a 2,4,5-T diesel oil solution colored with aniline red was used, the chemical entered the bark through fissures and lenticels and moved rapidly into the sapwood. Removing the bark prevented the chemical from moving down. When the xylem was removed, the chemical did not move up. This shows that the chemical moves up in the xylem and down in the bark. The tangential movement of chemical was negligible.

The 2,4,5-T increased the osmotic pressure of parenchyma cells resulting in greater water intake. Water loss through transpiration was retarded by foliage killing. Therefore treated aspen bark and wood contained more moisture.

Peeling resistance of untreated trees was least during

the period of rapid growth. A layer of new unlignified thin-walled wood cells without secondary thickening was formed. In trees quickly killed during the growing season by the chemical, this weak layer of new wood was preserved and lignification and secondary thickening prevented. As a result chemically-treated trees peeled very easily. Tyloses formed abundantly in the sapwood of treated aspen.

Bolts from treated trees were easily peeled when air seasoned for four weeks even though the moisture content was reduced from about 100 to 30 percent. Therefore, chemically induced ease of peeling can be maintained when the trees are left standing or stored as pulpwood bolts.

Chemically debarking aspen did not seriously retard suckering; and would, therefore, not prevent aspen from re-establishing a second crop.

156 pages. \$2.05. Mic 57-1878

AGRICULTURE, PLANT CULTURE

MINERALOGICAL COMPOSITION OF GLACIAL
MATERIALS AS A FACTOR IN THE GENESIS AND
MORPHOLOGY OF SOME MICHIGAN SOILS

(Publication No. 20,071)

Harry Hudson Bailey, Ph.D.
Michigan State College, 1956

Studies were made of the texture and the mineralogical composition of the glacial materials beneath 23 soil series in Michigan. The relationships of the properties of these materials to the characteristics of the soils and their classification were investigated.

Thirty-nine soil sites representing the twenty-three soil series were studied. Samples from each site were treated to remove surface coatings and stainings on the mineral grains. They were then separated into sand, silt and clay fractions. The mineralogy of the clay as previously determined by other investigators was reported.

The sand and silt fractions were analyzed by X-ray diffraction using powder camera and recording Geiger-counter goniometer techniques. Quartz, feldspars and plagioclases were determined quantitatively and expressed as weighted percentages of the total, using the percentages of sand and silt as shown by mechanical analyses.

The data for the various glacial materials were graphed to show the relationships of their mineralogy to the calculated number of particles per gram of sample. As the number of particles per gram increased: the percentages of quartz, K-feldspars and plagioclases decreased, and the clay minerals, especially kaolinite, increased. With increase in number of particles per gram of sample, there was also an increase in percent of sample unidentified.

Generally there was a greater amount of clay in subsoils than in surface soils, except in the Humic Gley soils from coarse textured materials. On coarse textured materials, both horizons showed small increases of clay over that in the parent rock. On finer textured parent rocks, surface soils generally contain less clay than the original materials. The subsoils of the Gray-Brown Podzolic soils

showed increases in clay over that in the parent rocks, except on those containing more than 45% clay. The surfaces and subsoils of the Humic Gley soils from northern Michigan decreased in clay content but the subsoils decreased less than the surface soils. Above 45% clay in the parent rock, there was a loss of clay in surface and subsoil compared to the parent rocks in nearly all cases, however, the subsoil clay still exceeded the surface clay content. Thus it appears that texture of the parent rocks has a strong influence on profile differentiation.

Summation of the mineralogical compositions shows that the Miami, Conover, and Brookston series are a true toposequence of soils. It was concluded that field identification procedures appear to be reliable in identifying soil series within a toposequence.

There was a tendency for the percent of K-feldspars to increase as the available K in the solum increased. Frequently, low available K in the solum was associated with a high percentage of unidentified clay.

Few geologic or soil investigations of mineralogical compositions were available for correlation. Standardization and improvements of methods or techniques are needed before reliable cross-referencing can be easily accomplished.

On the basis of this investigation and the results of others, it was concluded that a recording Geiger-counter goniometer X-ray diffraction technique was a rapid and useful method of mineralogical analysis when careful standardization of equipment, techniques and interpretations is maintained. 156 pages. \$2.05. Mic 57-1879

EFFECT OF SUPPLEMENTAL IRRIGATION UPON THE NITROGENOUS COMPOSITION OF LEAVES AND STEMS ADJACENT TO THE FRUIT AND UPON FRUIT SIZE AND QUALITY OF THE JONATHAN APPLE

(Publication No. 21,423)

William DeWitt Benedict, Ph.D.
The Ohio State University, 1956

The use of supplemental irrigation is a relatively new cultural practice in fruit production in the Midwestern states, and information is lacking concerning the effects of additional water on the chemical and physiological processes of many of these horticultural crops. Ascertaining the effects of additional water on the nutritional status and yield of these crops becomes more important with the increase in the prevalence of irrigation systems.

This experiment was established to determine the effects of supplemental irrigation upon the nitrogenous composition of leaves and stems adjacent to fruits of Jonathan apple trees. Soil moisture levels were maintained by cultural and irrigation treatments which consisted of sod, mulch, sod plus irrigation, and mulch plus irrigation. Precipitation and soil moisture data were taken throughout the two-year period. Three inches of additional water were applied two weeks prior to harvest in 1954, while a total of ten inches of water was applied to the irrigated plots during the 1955 growing season in addition to the natural precipitation. Rainfall during both periods was quite abundant.

Leaf, stem, and fruit samples were taken four times

during the 1955 season, frozen, and dried by lyophyllization. Total nitrogen and amino, amide, hydrolysis resistant, and hydrolyzable nitrogen fractions were determined on the dried leaf samples from each tree. Fruit growth measurements and yield data were taken during both years of the experiment. The fruit was graded visually for surface color, and samples were analyzed for soluble solids and titratable acids content. Pressure tests were carried out to determine the rate of softening of the fruit held in storage.

The application of additional water through irrigation did not significantly affect the nitrogenous composition of leaf and stem samples of irrigated trees in comparison with that of non-irrigated trees in either the 1954 or 1955 season. The rate of fruit growth and the average weight per fruit were related more to the total amount of fruit on the trees than to the different soil moisture conditions. The storage life and chemical composition of the fruit were not significantly affected by small changes in the soil moisture so long as it remained significantly above the wilting percentage. However, since excessively high soil moisture conditions were not obtained detriment to the storage life or quality of the fruit did not result.

Averages of the total nitrogen and the various nitrogenous fractions from all trees included in the experiment showed the seasonal cyclic relationship of forms of nitrogen in leaves and stems. The total nitrogen content of median and cluster base leaves decreased from July to September, while the total nitrogen content of one year wood and secondary shoots increased. Leaf samples contained three to four times the amount of amino acids found in woody tissues, while the amide content of one year wood and secondary shoots averaged three to four times the amount found in leaves. Cluster bases contained nearly five times the amount of amides found in other woody tissues. Hydrolysis resistant nitrogen was higher in leaves than in woody samples. The hydrolyzable or "translocatable" nitrogen fraction of cluster bases was two to three times the amount found in other woody tissues.

111 pages. \$2.00. Mic 57-1880

IRON PHOSPHATE SOLUBILITY PRODUCT AND THE DISCRETE CHEMICAL FORMS OF INORGANIC PHOSPHORUS IN SOILS

(Publication No. 20,228)

Shou Ching Chang, Ph.D.
The University of Wisconsin, 1957

Supervisor: Professor Marion L. Jackson

The concentration of phosphorus in the soil solution is most likely governed by the nature and the solubility product of solid phosphate species in the soil. In this research, the solubility product of iron phosphate, which was yet unknown, was determined by both dissolution and precipitation techniques in buffered solutions. The equilibrium phosphorus concentration in relation to the concentrations of other ions were studied in soil suspensions. The solubility of synthetic iron and aluminum phosphates and apatite in neutral ammonium fluoride, sodium hydroxide and sulfuric acid solutions was investigated as a control on the

method of fractionation of soil phosphorus into discrete chemical forms. The results of this research are summarized as follows:

First, the solubility product K of iron phosphate was calculated from the equilibrium activities of Fe^{3+} , H_2PO_4^- and H^+ by the equation:

$$\text{pK}_{\text{sp}} = \text{pFe}^{3+} + \text{pH}_2\text{PO}_4^- + 2\text{pOH}^-$$

It was found that the pK_{sp} value decreased with 1000-fold increase of the solid-to-solvent ratio from 35.0 to 33.6 at room temperature and from 35.1 to 33.4 at steam plate temperature. It increased from 33.0 to 33.2 over a 50-fold decrease of the concentration of the precipitation reagents. The larger solubility which was associated with the more concentrated precipitation reagents was attributed to the finer crystals formed which, like a higher solid-to-solvent ratio, supported a larger solubility owing to greater surface.

Second, the pK_{sp} values of calcium phosphate, aluminum phosphate and iron phosphate calculated from the activities of the various ionic species in the equilibrium solutions of the four soil samples of different nature suspended in 0.05 M KCl were found to be a linear function of pH over a certain pH range. The chemical potential of phosphate in relation to the chemical potential of calcium hydroxide, iron hydroxide or aluminum hydroxide is parallel the dicalcium, strengite or variscite lines over certain pH ranges.

Third, the control study showed that neutral ammonium fluoride dissolved aluminum phosphate completely, iron phosphate slightly and calcium phosphate negligibly. Sodium hydroxide completely dissolved both aluminum phosphate and iron phosphate but apatite not at all. Sulfuric acid dissolved apatite completely and also considerable aluminum and iron phosphates. Fifty ml of each extractant in proper sequence can completely remove the respective form of phosphate from the soil sample in one extraction. The residual occluded iron phosphate was dissolved in sodium dithionite-citrate. Occluded aluminum phosphate, left after the removal of iron phosphate, was then extracted by neutral ammonium fluoride.

Fourth, the fractionation of the phosphorus in twenty six soil samples of widely different nature showed that Latosols contain most of their phosphorus as occluded iron phosphate and are very low in calcium and aluminum phosphate. Chernozems are dominantly high in calcium phosphate, very low in iron and aluminum phosphate and almost negligible in occluded phosphate. Gray Brown Podzolic soils contain all the four forms of phosphate in a more even proportion. In two Miami silt loam profiles, calcium, iron and aluminum phosphate in the subsoil is about two or three times as high as in the surface soil. This explains the lack of crop response to phosphate fertilizer in spite of the low available phosphorus in the surface soil. The phosphate fertilizer applied during ten years to Almena silt loam was changed into all the three phosphates in the soil, but the occluded phosphate remained unchanged.

The overall data indicate that the formation and distribution of the various discrete chemical forms of inorganic phosphates in the soil, the solubility products of phosphate species and the equilibrium concentration of phosphorus in the soil-water system are closely related.

131 pages. \$2.00. Mic 57-1881

EFFECTS OF MANAGEMENT ON FOOD RESERVES, ROOT ROT INCIDENCE, STAND, AND FORAGE AND SEED YIELDS OF RED CLOVER, *TRIFOLIUM PRATENSE* L.

(Publication No. 21,847)

William Lytle Colville, Ph.D.
The University of Wisconsin, 1957

Supervisor: Professor James H. Torrie

Failure of red clover stands has become a limiting factor in the production of this legume in the North central states. Studies were conducted at Madison, Wisconsin, over a three year period (1953-55), on the effects of various management practices on red clover.

Dollard and Wisconsin Mildew Resistant (WMR) red clovers were subjected to two fall management practices in the seedling year. One group of plots was clipped on August 20 and another group was clipped twice, once on September 15 and again on October 15, to obtain two extremes in the effects of seedling year management.

The first crop of forage was removed at four stages of maturity. One group was spring clipped and later harvested at the 50 percent bloom stage. Other plots were harvested at the late bud, 50 percent bloom and the past full bloom stages of maturity.

Effects of these treatments on the physiology of the plants were measured by total available carbohydrate reserves in root tissues, incidence of root rot infection, crude protein content of the forage, plant counts, and forage and seed yields.

Dollard was superior to WMR in total yields of forage and in ability to survive into the second cutting year. The ability of Dollard to survive into the second cutting year was in part due to a lower root rot incidence in WMR.

Clipping once in the fall of the seedling year resulted in increased yields of forage in the first cutting year over similar plots clipped twice. Reduction of stands during the seedling year was largest on plots clipped twice. No differences were found between the two fall management treatments in food reserves or in root rot incidence.

The effects of poor fall management were found in forage and seed yields of the first cutting year, but long term progressive deterioration of stands or plants was not found. Forage quality as measured by crude protein was not influenced by fall management.

The stage of maturity at which the first crop of forage was removed influenced yields and quality of the forage. Crude protein and yields of first crop forage were positively correlated. No carry-over effect of stage of maturity was found on second crop yields or quality. Plots clipped at the late bud stage were generally lower in root rot, higher in stored root reserves and in second year stand survival, than other treatments. Forage yields were higher at the past full bloom stage of maturity, followed by 50%B, SC, and LB.

Seed yields were highest for WMR, Fall I and the intermediate maturity stages of first crop removal. Harvesting the second crop for seed as compared to forage, resulted in lower vigor, less food reserve storage, smaller root size, lower stands and forage yields in the second cutting year.

Climatic conditions appear very important to success or failure of red clover stands. Ideal climatic conditions

were shown to aid the production of new roots needed to replace those damaged by disease or winter-injury.

The ability to recover rapidly in the spring of the year and compete with weed growth is extremely important. Significant negative correlations were found between weeds and yields or stands. 137 pages. \$2.00. Mic 57-1882

**THE CHARACTERISTICS OF SIX BROMEGRASS
(*BROMUS INERMIS* LEYSS.) CLONES, THEIR
POLY-CROSS AND SINGLE CROSS PROGENY**

(Publication No 21,241)

Donald Dwight Dickenson, Ph.D.
University of Minnesota, 1957

Adviser: H. L. Thomas

Seven bromegrass clones, most of their intercrosses, and their polycrossed progeny, were tested in an individual plant nursery with 15 replications at the Minnesota Agricultural Experiment Station.

Panicle production was induced in the greenhouse in six clones of smooth bromegrass (*Bromus inermis* Leyss.) only after day length was increased from 10 to 18 1/2 hours. A cold (0° F. for one week) pre-treatment before planting generally was not beneficial. More panicles were produced on plants grown one more month at 65-70° F. (and day lengthened) than just three months at 55-60° F. (and day lengthened). The clones did not respond alike from one treatment to another, suggesting that genotypic differences exist for response to conditions necessary for induction of panicle primordia. Clone B41 produced significantly more panicles than the other clones.

While self seed set was less than one per panicle on unemasculated, bag-isolated panicles, hot water emasculation at a temperature of 47° C. for three and four minutes eliminated self seed production on all but one of the clones. Out crossing is offered as an explanation.

Several factors influenced crossed viable seedling production, but could not be analyzed. Sufficient seedlings were obtained on 26 out of 30 possible single crosses (including reciprocals) to plant a two plant plot of each in a field test of 15 replications. Clonal pieces and polycross seedlings of each clone were also included.

First year field data on the following 14 characters were analyzed by the analysis of variance: early spread, plant height, plant weight, date of first pollen shed, number of panicles in seed yield, seed yield, weight of seed per 100 panicles, early vigor, late vigor, panicle type, leaf scald, aftermath spread, rate of recovery, and amount of aftermath. The F test indicated significant differences existed among the genotypes for all characters studied.

The cross of B13 x B38 was significantly different from its reciprocal for height and date of first pollen shed. Possible explanations are offered.

Comparisons were made between clonal values and the average of their respective single crosses, and between polycross values and the average of single crosses in which the same female parent was used. The average of the single crosses was more nearly approximated by the polycrosses for the eight characters: plant weight, height,

seed yield, panicle type, rate of recovery, date of first pollen shed, amount of spread of aftermath, and amount of aftermath. For the other six characters neither clonal or polycross values agreed well with the average of single crosses. A possible explanation for lack of agreement of clonal values with average of single crosses is that the clonal pieces did not become established as well, or as fast, as the seedling transplants.

Instances of specific combining ability were noted when individual crosses were compared with the polycross or the average of single crosses with the same female parentage.

The nursery was studied by David Timothy for three more years subsequent to the preparation of this manuscript. From all of the data collected it appears that under the conditions of this experiment and for the bromegrass clones used, general combining ability is the rule and specific combining ability is rather infrequent.

50 pages. \$2.00. Mic 57-1883

**INFLUENCE OF POLLEN PARENT UPON THE
DEVELOPMENT OF PERICARP IN SWEET CORN
(*ZEA MAYS SACCHARATA*)**

(Publication No. 21,479)

Constantinos Demosthenes Kadinopoulos, Ph.D.
The Ohio State University, 1957

A comparative study was made to determine the influence of the pollen parent upon the development and final structure of the pericarp of selfed and outcrossed inbred lines of sweet corn. Ten inbreds differing in endosperm complex and pericarp thickness were planted in the summer of 1955. Reciprocal crosses were made among these inbreds on the third day after silk emergence, and ear samples were collected at 5-day intervals from the fifth to the forty-fifth day after pollination. Freehand and microtome median longitudinal and cross sections were prepared for morphological and anatomical examination. The pericarp thickness was measured at the crown, middle germinal and abgerminal, and basal germinal and abgerminal regions. The pericarp weight and the percentage of pericarp on the dry weight basis were also determined. Reciprocal crosses were also made at 1, 2, 3, 5, 6, 9, 12, and 15 days after silk emergence, to determine the effect of delayed pollination upon the seed set and final structure of pericarp.

The developmental morphology of the pericarp, the thickness, weight, and percentage of pericarp of the hybrid kernels, was compared with that of the parental inbred lines. In general, the hybrid kernels followed the same pattern of pericarp development as that of the maternal inbreds and were substantially different from that of the paternal inbreds. Pericarp thickness was variable at all measured areas of the kernel, and the differences between the selfed and outcrossed inbred lines did not progress in a definite pattern. Differences in the rate of development of pericarp were noted between the hybrid kernels and the maternal inbreds. A maximum in pericarp thickness was reached in 5 to 10 days after pollination at the crown, and in 10 days at the germinal and abgerminal, 15 to 30 days at the basal germinal, and 10 to 30 days at the basal

abgerminal regions. Small differences were found between the hybrid kernels and the maternal inbreds in the time at which disintegration began, in the rate of disintegration of the cells of the inner pericarp, and in the thickening and lignification of the tangential and radial walls of the outer pericarp. The above observed differences in the morphology of pericarp between the selfed and outcrossed inbreds probably were due to heterosis.

There were no significant differences in the weight of pericarp between the hybrid kernels and the maternal inbreds, while a positive correlation was found between the weight of pericarp and the total weight of kernel. No relationship was found between thickness and weight of pericarp or between thickness of pericarp and total weight of kernel.

The mean maximum seed set was obtained when pollination was accomplished three days after silk emergence. The earlier the variety, the sooner the silk lost its receptivity. Delaying pollination up to the fifteenth day after silk emergence had no influence upon the thickness or final structure of pericarp.

From the study it is concluded that when inbred lines are outcrossed with pollen from a line differing materially in endosperm complex, the pollen parent influences the rate of development of pericarp of the hybrid kernels but does not materially influence its final structure.

319 pages. \$4.10. Mic 57-1884

THE EFFECT OF CERTAIN NUTRIENT ELEMENTS UPON THE HYDROCYANIC ACID CONTENT OF SUDAN GRASS GROWN IN SOLUTION CULTURE

(Publication No. 21,226)

Chhotabhai Jethabhai Patel, Ph.D.
The University of Wisconsin, 1957

Supervisor: Professor Madison J. Wright

A lack of agreement among workers as to the effects of environmental factors on the HCN content of sudan grass and sorghum led to the initiation of the present study. The effects of different levels of nitrogen, phosphorus and potassium on the development of HCN content at different periods of growth in two strains of sudan grass grown in nutrient solution were studied in the greenhouse from the spring of 1955 to the fall of 1956.

On the basis of the preliminary work done from May, 1955 to March, 1956 with each of the three nutrient elements and two strains of sudan grass, viz., Sweet Sudan and Line 109, experiments in two parts were conducted from April, 1956 to November, 1956. Part I consisted of two experiments with three levels of potassium and Part II consisted of four experiments with nine nutrient levels (3N x 3P - low, optimum and high levels in each).

Plants were grown in Hoagland's nutrient solutions and sampled for HCN content at intervals of five days beginning with 15 days and continuing until 35 days of growth.

The results of the experiments revealed the following:

- a. The differences in the HCN content of plants were not significantly influenced by the levels of potassium at any period of growth in either of the

varieties of sudan grass; differences were significant only in Sweet Sudan in experiments involving the levels of nitrogen and phosphorus.

- b. Under the conditions imposed, 20-day-old plants of Sweet Sudan, irrespective of treatment differences produced the highest amounts of cyanide in most cases. The concentrations of HCN declined sharply between 20 and 25 days of growth in most of the treatments, and then more slowly, reaching a comparatively low level at 35 days.
- c. The plants receiving $N_0 P_0$ (low-nitrogen and low-phosphorus) and $N_0 P_1$ appeared to develop significantly higher concentrations of HCN than those given $N_0 P_2$, $N_1 P_1$ or $N_1 P_2$ around 20-25 days of growth. With advancing growth these differences were levelled off. Treatment $N_0 P_2$ produced comparatively low concentrations of HCN in plants throughout the growing period.
- d. The plants that received $N_1 P_0$ tended to produce significantly more cyanide than those given $N_1 P_1$, $N_1 P_2$ and $N_0 P_2$ at 20 days, and more than those given any other N_0 or N_1 treatment beyond this stage. Treatments $N_1 P_1$ and $N_1 P_2$ appeared to produce alternate rises and falls in the HCN-concentrations of plants. The former developed more cyanide in plants than $N_1 P_0$ or $N_1 P_2$ only at 15 days, while the latter developed more than the N_0 , and the rest of the N_1 , treatments at 30 days of growth.
- e. Among the high-nitrogen treatments, $N_2 P_0$ and $N_2 P_1$ built up high concentrations of HCN in plants and tended to be in the highest range throughout the growing period, while treatment $N_2 P_2$ seemed to develop comparatively high concentrations in plants only early in the testing. Thus the results on the whole reveal that the addition of nitrogen beyond optimum requirements for plant growth certainly increases the concentration of HCN in sudan grass.

As to the treatment effects on the height of plants, low levels of nitrogen (N_0) as compared to optimum and high levels of nitrogen (N_1 and N_2) produced small plants. An association between shortness and high HCN early in the testing and shortness and low HCN later on appeared to exist in plants of Sweet Sudan given $N_0 P_0$ and $N_1 P_1$. No consistent relationship between either per cent dry matter and height, or per cent dry matter and concentration of HCN, was found.

115 pages. \$2.00. Mic 57-1885

A STATISTICAL EVALUATION OF EARLY
GENERATION TESTING IN A BARLEY CROSS USING
RELATED F_3 , F_4 , AND F_5 LINES GROWN
SIMULTANEOUSLY

(Publication No. 21,256)

Glenn Arthur Peterson, Ph.D.
University of Minnesota, 1957

Adviser: J. W. Lambert

Hybridization followed by selection in segregation populations is the most commonly used method in barley varietal improvement. It would be helpful to the plant breeder if promising material could be isolated as a result of early generation progeny testing within crosses. This would facilitate elimination of inferior lines within crosses or even entire crosses so that time and effort could be devoted to the superior selected material. An evaluation of the usefulness of early generation testing in barley and the stage of inbreeding at which effective selection may be made for various agronomic characters were the objectives of the study.

Thirty families each including related F_2 , F_3 , and F_4 plant progenies which were randomly selected in the barley cross, Montcalm x Feebar, were grown in the F_3 , F_4 , and F_5 generations, respectively, as a single replicated trial. Data were obtained for the agronomic characters, heading date, maturity date, plant height, lodging score, head erectness, visual rating, bushel weight, 200 kernel weight, "thins", and yield. Analyses of variance, genetic variance components estimated from the variance analyses, and comparisons of the means were used to evaluate the variability and relationships within and among generations for each of the ten agronomic characters. Heritability estimates in the narrow sense were obtained for each character within each of the three generations studied.

The measurements on F_3 lines for heading date, maturity date, and plant height appeared to be highly predictive of mean progeny performance in the F_4 and F_5 generations. On the basis of the reported degree of complexity of inheritance and the magnitude of the heritability estimates obtained in the F_3 and F_4 generations for heading date and maturity date, selection of individual plants for these two characters appears to be more efficient than selection based on early generation progeny testing. The heritability values for plant height were the largest obtained for any of the ten agronomic characters studied. The data presented indicated that a moderate degree of genetic advance may be expected for the characters, 200 kernel weight, "thins", head erectness, and bushel weight, by selection for differences among F_3 lines. Heritability estimates for lodging score, visual rating score, and yield were among the lowest of any of the ten characters studied. Early generation testing for yield and visual rating score of F_2 plant progenies in the F_3 generation appeared to be of little value in predicting breeding behavior in the F_4 and F_5 generation while early testing for lodging score was only slightly more effective.

In general, a comparison of the genetic variance component associated with the differences between F_5 lines from an F_4 line with other variance components estimated in the study indicated a relatively high degree of homozygosity was attained for the factors controlling the ten agronomic characters in the F_5 generation. The selection

for differences among sister F_5 lines in order to obtain an advance in genotypic superiority did not appear warranted for these agronomic traits.

81 pages. \$2.00. Mic 57-1886

HISTOLOGICAL CHANGES AND NUTRIENT LOSSES
FROM PLANT FOLIAGE UNDER MIST PROPAGATION

(Publication No. 20,087)

Dale Vernon Sweet, Ph.D.
Michigan State University, 1956

The effect of a mist treatment on the leaching of root and non-root absorbed radioactive phosphorus³², potassium⁴², and rubidium⁸⁶ from plant foliage was investigated to determine the nutrient losses from cuttings of certain horticultural plants which were placed under the mist method of propagation. Studies of misted and non-misted cross sections of leaves and stems of *Phaseolus vulgaris* (variety Cranberry), *Malus sylvestris* (Malling IX), and *Prunus mahaleb* (clone 3-16) were included to observe any histological changes which may have occurred during the water-mist treatment.

Rosa odorata (variety Better Times), and *Phaseolus vulgaris* (variety Cranberry) absorbed radioactive phosphorus³² for forty-eight hours through the cut surfaces of their stems prior to being placed under a water-mist spray for a similar period of time. The leachate was collected and analyzed for radioactive phosphorus³² which was expressed in per cent of total uptake of the isotope in the misted cuttings.

Phaseolus vulgaris (variety Cranberry), and *Ipomea batatas* (variety Gold Coast) which had absorbed phosphorus³² through their root systems were not leached of the tracer under the water-mist treatment.

Root and non-root absorbed radioactive potassium⁴² was recovered in greater quantities from the leachate of *Phaseolus vulgaris* (variety Cranberry), *Euphorbia pulcherrima* (variety Albert Ecke), and *Ipomea batatas* (variety Gold Coast) when absorption had occurred in the dark prior to the water-mist treatment. The greatest amount of leaching of radioactive potassium⁴² occurred when the isotope was absorbed in the dark through the cut stem surfaces of plant materials.

Comparative percentages of the leaching of root-absorbed rubidium⁸⁶ from softwood cuttings of *Phaseolus vulgaris* (variety Cranberry) which had received different environmental conditions prior to a forty-eight hour mist treatment indicated that the greatest loss of the isotope occurred after absorption of the rubidium⁸⁶ at full nutrient levels in the dark as compared to low nutrient cultures. Those plants which had absorbed rubidium⁸⁶ in the light under either high or low nutrient levels were not significantly different in percent of leaching of the tracer during the water-mist treatment.

Histological changes were observed between misted and non-misted cross sections of leaves and stems of plant materials. An absence of reserve foods in the palisade layers of the leaf sections was accompanied with early maturation and accumulation of carbohydrate products in the stem tissues of misted plants as compared to non-misted plants of the same physiological age. 86 pages. \$2.00. Mic 57-1887

STUDIES ON THE DISEASE CYCLE OF ANGULAR LEAF SPOT OF CUCURBITS

(Publication No. 21,232)

Seymour Dean Van Gundy, Ph.D.
The University of Wisconsin, 1957

Supervisor: Professor J. C. Walker

The purpose of this study was to seek more information on the disease cycle of angular leaf spot of cucumber (*Cucumis sativus* L.) incited by *Pseudomonas lachrymans* (Smith and Bryan) Carsner. The physiology and pathogenicity of isolates of the organism collected from Wisconsin, Colorado, California, Maryland, Canada and Denmark were similar.

The organism was seed-borne and persisted in infested soil and/or plant debris through one winter. It remained viable for 2 1/2 years in desiccated tissue. All of the 18 species of cucurbits tested were susceptible. The young fruits were more susceptible than fruits reaching mature

size. Eight species in the Leguminosae and Solanaceae did not serve as alternate hosts.

In culture inorganic nitrogen did not serve as a nitrogen source with or without addition of vitamins. Of 15 amino acids tested only glutamine, asparagine, arginine and aspartic acid could be used as a source of nitrogen. Asparagine used as the source of organic nitrogen in culture was the deciding factor for growth and pigmentation. The minimal critical nitrogen level for maximum growth in 36 hours was 100 μ g N/ml of medium.

Disease development was greatest at 16° day, 28° night treatment, followed by 16° constant, 28° constant, and 28° day, 16° night. The plants at 16° day, 28° night temperatures had the highest concentration of amino nitrogen followed by those at 16° constant, 28° day, 16° night, and 28° constant in respective order.

Plants grown at high N and low K gave high disease indices. There was a direct correlation between host nutrition and amino-nitrogen content of cucumber leaves; likewise, there was a direct correlation between amino-nitrogen content of leaves and disease index.

83 pages. \$2.00. Mic 57-1888

ANATOMY

AN ELECTRON MICROSCOPE STUDY OF THE UPTAKE AND BILIARY EXCRETION OF SUBMICROSCOPIC PARTICLES BY HEPATIC CELLS, FOLLOWING INTRAVENOUS AND INTRABILIARY INJECTION OF THOROTRAST AND COLLOIDAL MERCURIC SULFIDE PARTICLES

(Publication No. 21,205)

James C. Hampton, Ph.D.
University of Washington, 1957

Colloidal suspensions of Thorotrast and mercuric sulfide particles were administered to rats by intravenous and intrabiliary injection. The animals were sacrificed by perfusing the liver with fixative via the portal vein. Sections of tissue were studied in the electron microscope.

In livers fixed immediately after intravenous injection, single colloidal particles and small particle aggregates were seen within the hepatic cells. As the interval of time between injection and sacrifice was extended, up to five weeks, there was a tendency towards large particle aggregates and incorporation of the particles into the peribiliary body. Bile samples collected at intervals over the five week period showed that both HgS and ThO₂ appeared in the bile within 30 minutes after injection and were continuously secreted thereafter.

Colloidal HgS was administered by retrograde injection of the bile duct at low pressure for 1/2 hour. Under these conditions the material appeared in the hepatic cells in the form of single scattered particles, and was found in the space of Disse and in the Kupffer cells in the form of small aggregates.

The observations obtained in this study have shown that intravenously injected particles of ThO₂ and HgS are

removed from blood plasma in the space of Disse by the hepatic cells, transported across the cells, and then discharged into the bile capillaries.

After retrograde injections of colloidal material into the bile duct, colloidal particles are transported across the hepatic cells from bile to blood plasma.

The relationship of fibrin to particle size and phagocytosis of particles has been discussed.

78 pages. \$2.00. Mic 57-1889

CORTICAL ASSOCIATION SYSTEMS RELATED TO AUDITORY FUNCTIONS

(Publication No. 21,330)

Edith Marie MacLennan, Ph.D.
University of Michigan, 1956

The thesis is concerned with a study of the auditory and vestibular pathways in the central nervous system. The experimental animals were monkeys of the species *Macaca mulatta* and *Macaca irus* (=cynomolgus). Lesions were placed in auditory and vestibular centers and pathways by ablation or by electrocoagulation using the Lab-Tronics stereotaxic instrument. A period of two weeks was allowed before each animal was sacrificed. The brain of one animal was stained by the Huber-Guild Pyridine-Silver method. The remainder of the material was processed according to the Swank-Davenport modification of the Marchi technique. The efferent pathways from the areas of the lesions were followed by tracing the degenerated fibers which had resulted from the ablations.

It was found, as previous workers had discovered, that the medial geniculate nucleus of the dorsal thalamus projects to the superior surface of the homolateral superior temporal gyrus. After removal of this projection area on the superior temporal gyrus, degenerated fibers could be traced to the adjacent area 22, the auditory association area. When area 22 had been destroyed, degenerated fascicles were evident in the temporal pole, the island, the frontal and parietal cortices and the occipitotemporal region. Lesions were then placed in some of the areas to which area 22 had been shown to be connected. After a lesion of the temporal pole, degenerated fibers extended into the globus pallidus and the putamen. When the island had been removed, degenerated fibers could be followed into the putamen. From the occipitotemporal region a degenerated fascicle extended into the occipital cortex, and degeneration was also found in the superior colliculus and medial longitudinal fasciculus.

The data obtained from the destruction of the medial geniculate nucleus, the primary auditory area and area 22 can be closely correlated with data obtained by neurophysiological methods. The efferent connections of area 22 to other cortical areas are significant because these latter areas have been described as second motor areas, and such pathways are possibly used to bring correlated auditory impulses to such motor regions. When some of the second motor areas were destroyed, degeneration was found in the basal ganglia. The basal ganglia are known to be part of the discharge arcs of second motor areas and, thus, belong to the extrapyramidal systems. The close anatomical relations of auditory and visual association centers are to be expected and are shown anatomically in this study by connections from area 22 to the occipitotemporal region and from the latter into the occipital region.

One lesion was made in the vestibular area in order to discover, if possible, a pathway to the thalamus. Following the lesion, degenerated fibers could be traced into the medial longitudinal fasciculi, but no rostral degeneration to the thalamus was demonstrated. That such a vestibulo-thalamic degeneration was not found may have been due to the diffuseness of the system or to the fact that it is a multisynaptic system. 76 pages. \$2.00. Mic 57-1890

CERTAIN DIENCEPHALIC NUCLEAR AREAS WHICH PRODUCE MOVEMENT UPON ELECTRICAL STIMULATION

(Publication No. 21,362)

Alma Mary Stoiber, Ph.D.
University of Michigan, 1956

A study of certain diencephalic nuclear areas in the monkey (*Macaca mulatta*) was carried out with two purposes in mind. The observer wished to determine the types of movement that could be elicited from these areas by means of electrical stimulation and to note any abnormal movements that might develop in the animal following electrolytic destruction of the same areas.

Using ether anesthesia, a trephine opening was made in the skull and a unipolar or a bipolar concentric electrode was inserted into the brain by means of a stereotaxic

instrument. The stimulating current was in the form of a continuous train of square wave pulses delivered for a period of sufficient length to allow any induced movement to develop to its maximum. Such movements involved predominantly the extremities, followed a brief latent period, and exhibited both phasic and tonic components. The areas so stimulated included a number of dorsal thalamic, ventral thalamic, and hypothalamic nuclei. The nucleus ventralis lateralis of the dorsal thalamus was stimulated more extensively than other areas.

The various stimulated points were then cauterized with direct current and the animal allowed to survive for a period of two or three weeks during which time he was observed for the appearance of abnormal movements. At the end of this period the animal was anesthetized, perfused, and the brain removed. Microscopic sections were prepared by the Marchi method. In such preparations, the positions occupied by the electrode during the process of stimulation could be determined and, in a few cases, pathways of degeneration followed from the cauterized areas.

The movements produced by such stimulation are described and the positions from which they were elicited indicated by means of sketches and photomicrographs of the microscopic sections. A discussion of the fiber connections of the various areas stimulated with the cerebral cortex, the basal ganglia, and the tegmental regions of the midbrain is presented. Such connections, by their relays to motor centers, account for the movements produced. Any diencephalic area so stimulated is represented as part of a complete motor arc from periphery to cerebral cortex and back to the periphery.

Particular attention is given to movements elicited from the nucleus ventralis lateralis of the dorsal thalamus. These movements occurred in a pattern. Face movements were demonstrated from the most medial part of the nucleus. These were followed laterally and dorsolaterally by an area from which upper extremity movements were obtained. Most laterally, stimulation produced lower extremity movements. The region within this nucleus from which arm movements can be obtained is the largest of the three areas. As a result, random stimulation of this nucleus most frequently produced movements of the upper extremity. A discussion of the position of this nucleus within the dentorubrothalamocortical system is presented.

The development of abnormal movements in the surviving monkeys is described. These included a mild intension tremor and, in one instance, suggested a choreoathetoid movement.

As a supplement to this study of diencephalic areas, an ablation of the rostral border of the arm area of the motor cortex was made. Extirpation of the head of the caudate nucleus bilaterally was also carried out.

The observer concluded that any particular nuclear area which yields body movement upon adequate electrical stimulation must be considered as part of a complete neuron arc from periphery to the center and back to the periphery. Such movements can be elicited from any position along this arc. These experiments involved various nodal points in this arc.

A total of eleven monkeys was used. Of these, two were utilized for the cerebral cortical lesions, one was subjected to bilateral destruction of the head of the caudate nucleus, and stimulation and destruction of the thalamus was done in nine monkeys.

146 pages. \$2.00. Mic 57-1891

ANTHROPOLOGY

IROQUOIS CULTURE HISTORY IN THE NIAGARA FRONTIER AREA OF NEW YORK STATE

(Publication No. 21,373)

Marian Emily White, Ph.D.
University of Michigan, 1956

The purpose of this study was the establishment of a chronological sequence for the ceramic cultures in the Niagara Frontier Region of Western New York. These cultures were represented by collections of artifacts from seven archeological sites. A secondary problem was the selection and application of certain statistical methods which would permit reliable comparison and ranking of these seven sites so that chronology might be inferred.

Pottery vessels, pipes, projectile points, and settlement pattern were selected as the sources of the comparative data. The procedure varied with the attribute or attribute combination selected. In some cases the frequencies were compared to provide an index of likeness for all possible pairs of sites. Among the indices used were ϕ , the coefficient of association, and Robinson's coefficient of agreement. In other cases the presence or absence of certain attributes was noted for comparative purposes.

The sites were then ranked to determine whether or not a systematic relationship existed with respect to similarities and differences in these attributes and attribute combinations. The ranking was done by following the method suggested by Robinson or by arranging the indices in ascending or descending order. The one arrangement which was shown to be the best arrangement for the attributes considered independently, was considered to be the best arrangement of the sites.

Under the assumption that the differences between sites were due to differences in time rather than in space, the best arrangement of sites was considered to be the best chronological arrangement. The validity of this assumption was based on the fact that the Niagara Frontier was a single, homogeneous, geographical area. This was investigated in a discussion of the geography of the Niagara Frontier.

The best arrangement of the seven sites was as follows: Oakfield, Kienuka, Shelby, Buffam Street, Eaton, Goodyear, and Green Lake. This was also the chronological arrangement of the sites from early to late. The identity of the historic inhabitants of the area was shown by ethnohistory to be the Iroquois Indians. Three Iroquois groups, the Neutral, Wenro, and Erie, inhabited the area during this time but no village of any of these groups has been documented. The last two sites of the sequence, Goodyear and Green Lake, were inhabited during this time and probably dated between 1550 and 1630 A.D.

The seven sites were assigned to temporal subdivisions within the Late Woodland Period. The culture history of the area was reviewed in terms of the changes in the popularity of artifact attributes during these periods. Finally

comparisons were made with Iroquois cultures in nearby areas. The greatest similarities were noted between the Iroquois cultures of the Niagara Frontier, the Ontario Peninsula and the Genesee River drainage.

260 pages. \$3.35. Mic 57-1892

SOCIALIZATION IN A PAPAGO INDIAN VILLAGE (PARTS I-III)

(Publication No. 19,393)

Thomas Rhys Williams, D.S.S.
Syracuse University, 1956

This report describes the process of socialization in the village of Gu Achi on the Papago Indian reservation in southwestern Arizona. It is an account of how the children of this village are taught the customary forms acceptable to the adult members of the community.

The socialization process is discussed in three basic aspects. First: forms common to the adults of the village; forms that the adults say are appropriate for participation in the daily life of the community. Second: the means by which adults transmit to the children the approved behavior forms. Finally, a descriptive account of the individual child's participation in the socialization process.

Thus, the report comprises three parts. In Part One, on the setting of the study, Chapter One summarizes the geography, history, language and physical characteristics of the Papago people, while Chapter Two describes life in the village studied.

Part Two describes the process of socialization in the village. Chapter Three is an account of family life and its part in the socialization process. Chapter Four deals with the learning of approved behavior forms by the child.

Part Three presents my opinions as to the major processes of socialization in this village. Chapter Five outlines these processes and presents my views about their importance in village life.

Since this report is a descriptive account of socialization in one Papago Indian community, all conclusions are confined to the fifth chapter. The descriptions are based upon data gathered personally while residing in the village; each statement is based upon events witnessed by me or reported by informants.

Major conclusions of the report: (1) There is no basic disagreement between this descriptive account of Papago socialization and that reported in *The Desert People* (Joseph, A., R. Spicer and J. Chesky, 1949, Chicago, University of Chicago Press), (2) the working hypotheses used in the field investigation, as formulated from researches in socialization, are not generally contradicted by data of this report.

269 pages. \$3.50. Mic 57-1893

ASTRONOMY

AN INFRARED ANALYSIS OF THE SCUTUM REGION

(Publication No 20,936)

Henry Albers, Ph.D.
Case Institute of Technology, 1956

The magnitudes and spectral classes of giant M stars have been determined in obscured and clear regions within the Scutum cloud to the 13th infrared magnitude. The interstellar absorption within the brighter parts of the cloud is low and the use of infrared techniques permits the identification of M stars to great distances. A density analysis of these stars indicates a concentration of early M stars within a spiral arm at a distance of 2000 parsecs. The late M stars do not indicate a space density maximum correlated with the position of this arm. In addition,

surveys of M stars were made in longitude and latitude across the cloud. They show that the M stars extend beyond the apparent visible limits of the cloud. This indicates that the apparent limits shown on photographs are due to foreground obscuration effects. The density analyses, together with a comparison of the magnitude distributions of the M stars in Cygnus and near the galactic center, indicate that the Scutum cloud represents a composite population. A large percentage of the early M stars are associated with the spiral arm while the majority of the late M stars are faint and apparently associated with the galactic nucleus. This conclusion is supported by the variable stars that in the Scutum cloud show a high percentage of cluster type variables indicating a population II system together with a high percentage of eclipsing binaries which are not normally found in such systems.

105 pages. \$2.00. Mic 57-1894

BACTERIOLOGY

METHODS FOR ESTIMATING THE PSYCHROPHILIC POPULATIONS AND KEEPING QUALITY OF MILK

(Publication No. 20,205)

Selwyn Arthur Broitman, Ph.D.
Michigan State University, 1956

PART I

Psychrophilic organisms are best defined, from the practical aspects, as those organisms which are capable of relatively rapid growth at refrigeration temperatures (4.5 C). The most commonly encountered genera are Pseudomonas, Achromobacter, Flavobacterium, and Alcaligenes. Members of the coliform group are encountered to a lesser degree.

These organisms are responsible for deterioration of refrigerated dairy products and since they are destroyed by both H.T.S.T. and L.T.L.T. pasteurization, their presence in freshly pasteurized milk is indicative of post-pasteurization contamination.

Many investigators have reported that the initial numbers of psychrophilic organisms in freshly pasteurized milk cannot be used as a "yardstick" to predict keeping quality of milk stored at refrigeration temperatures. That this is apparently true, is evidenced by the observations that certain species of organisms cause deteriorative changes in milk in a relatively short time while others ("inert" psychrophiles) reach extremely high population levels over long periods of time without causing noticeable flavor defects.

To date, the most satisfactory method for the enumeration

of psychrophilic organisms is a plate count on tryptone-glucose-extract agar incubated at 4.5 C for 7 days. This procedure is obviously too long for the routine enumeration of psychrophilic organisms. Again, at the present time a rapid test for the prediction of keeping quality of milk at refrigerated temperatures is lacking.

It was the aim of this thesis to: (1) develop a medium for the rapid enumeration of psychrophilic organisms and (2) develop a method that would find application in the routine prediction of keeping quality of milk stored at refrigeration temperatures.

A screening procedure using a solid medium was adopted to determine the most suitable peptone for the growth of representatives of the four psychrophilic genera (Pseudomonas fluorescens, Flavobacterium rhenanus, Alcaligenes viscosus and Achromobacter superficiale). Growth determinations in liquid media were carried out to determine the effects of varying concentrations of the peptone, nutritional additives, and hydrogen ion concentration.

Since 20 C is the approximate optimum temperature for growth of these organisms, it was selected as the incubation temperature. However, this temperature allows the growth of various mesophilic organisms, which are part of the normal flora of milk. Consequently, it was necessary to find an inhibitor which would prevent the growth of these mesophilic types, without interfering with the growth of psychrophilic organisms.

Various dyes and surface active agents were tested and Nacconol N.R.S.F. (an anionic wetting agent) in a concentration of 1:1000 was selected.

The Phytone-Nacconol medium was formulated as follows:

Phytone	20.0 gm
yeast extract	5.0 gm
KH ₂ PO ₄	0.1 gm
K ₂ HPO ₄	5.0 gm
Nacconol	
N.R.S.F.	1.0 gm
agar	15.0 gm
distilled	
water	1,000 ml
pH	7.5

(incubate plates at 20 C for 48 hours)

This medium was tested against the procedure in Standard Methods for the Examination of Dairy Products, (10th Edition). A statistical analysis demonstrated that there was virtually little difference between the two techniques.

PART II

A keeping quality test is also presented whereby a 10 ml sample of pasteurized milk is aseptically pipetted in a tube containing 1 ml of sterile Nacconol-tetrazolium test solution. The mixture is then incubated at 20 C for 12, 24, 36 and 48 hours.

The appearance of a positive tube (rose red color) after 12 hours indicates milk will retain its acceptability under refrigeration for approximately 4.2 days; a positive tube after 24 hours indicates acceptability for 8.8 days; a positive tube after 36 hours or after 48 hours is indicative that the milk in question will remain acceptable for 12.6 and 15.6 days respectively.

The formula for Nacconol-tetrazolium test is as follows:

2, 3, 5 triphenyl tetrazolium chloride	0.1 gm
Nacconol N.R.S.F.	1.0 gm
K ₂ HPO ₄	5.0 gm
KH ₂ PO ₄	0.1 gm
distilled water to make	100 ml

107 pages. \$2.00. Mic 57-1895

THE ROLE OF BACTERIA IN THE NUTRITION OF ENTAMOEBA HISTOLYTICA

(Publication No. 21,164)

Donald George Comb, Ph.D.
University of Michigan, 1956

The paucity of basic knowledge regarding the cultural requirements of *Entamoeba histolytica* stems primarily from the fact that a highly complex medium and a mixed unknown bacterial flora have generally been employed for the cultivation of this protozoan. The present investigation concerns (1) the effect of single closely related bacterial types on the *in vitro* growth of *E. histolytica*, and (2) the role of both the medium and the bacterial associates in fulfilling the growth requirements of this parasite.

A monoxenic culture of *E. histolytica* and an antibiotic-resistant strain of *Escherichia coli* was established by substituting the latter organism for the antibiotic-sensitive mixed flora of the 202 strain of amebae. Washed trophozoites from this monoxenic culture were used to assay the

growth-promoting capacity of many coliform bacteria. It was found that differences in the ability to support amebic growth existed between strains of the same species and even between mutants of the same strain. The differences observed could not be correlated with reducing activity, change in pH, or the amount of bacterial growth. Although certain bacteria proved to be unfavorable associates they were not toxic to amebae and were ingested to about the same extent as favorable bacteria. Evidence was presented suggesting that the elaboration of growth factor(s) by bacteria may be either reduced or enhanced by changing the nutrition of the bacterium.

The effect of various substrates in a defined medium on the growth of amebae and the bacterial associates was investigated. It was shown that the primary function of the medium is to provide for the growth of the associates which in turn reduce the oxygen tension of the medium and serve as a major source of nutrient for the amebae. Starch and cholesterol were also required by the amebae for growth.

It appears that the protoplasm of certain bacterial types supplies a growth factor(s) needed by *E. histolytica*. The distribution of this nutritive in bacteria is extremely variable; closely related strains show striking differences in their ability to support amebic propagation.

The cultural requirements of *E. histolytica* in monoxenic culture with *E. coli* were starch, cholesterol, and the bacterial associates. 142 pages. \$2.00. Mic 57-1896

STUDIES ON THE PURIFICATION OF RABIES VACCINE DERIVED FROM RABBIT BRAIN

(Publication No. 20,073)

Robert J. Gauthier, Ph.D.
Michigan State University, 1956

It has long been known that antirabic vaccines occasionally produce allergic encephalitis or other severe central nervous system reactions in vaccinated individuals. Although the cause of these reactions is not clear, most workers believe it to be an allergic reaction to the brain tissue contained in the vaccine. It is generally believed that post-vaccinal reactions could be greatly reduced if the vaccines were freed of most of the non-specific brain tissue. The vaccines must, however, be highly antigenic.

This investigation was undertaken to develop an acceptable method for the purification of rabies vaccine derived from rabbit brain. Our procedures employed zinc precipitation of the antigen followed by selective dissociation of the zinc complex.

These procedures, which incorporated pH changes, failed to purify the rabies vaccine without appreciably decreasing its antigenicity. Although attempts to purify the vaccine were unsuccessful, significant data were obtained concerning the nature of the rabies antigen.

Under the conditions employed, it was found that the rabies antigen was largely insoluble or poorly dispersed in aqueous and saline media. This was thought to be due either to the intimate association of the antigen with the brain substances or to its chemical composition. In any case, this insolubility was the apparent reason for the

inability of the zinc to precipitate the bulk of the antigen from the vaccine.

Sonic oscillation, under the conditions employed, greatly increased the antigenicity of the rabies vaccine. However, no comparable increase was found in its antigen solubility. The liberation of some insoluble antigen, which was zinc precipitable, followed sonic disintegration of the tissue cells.

Repeated freezing and thawing of the rabies vaccine resulted in the complete destruction of the antigenic component. Similarly, the extraction of the vaccine with ether or a mixture of ether and ethanol at low temperatures resulted in a great loss of antigenicity. There appears to be some similarity between the rabies antigen and lipid-protein combinations.

It was concluded that before any acceptable method of rabies vaccine purification could be developed, it will be necessary first to more adequately determine the chemical properties of the inactivated rabies virus. The intimate association of the antigen with brain substances or protective chemical complexes has defied most physical and chemical methods of separation without denaturation of the antigen. 64 pages. \$2.00. Mic 57-1897

LABORATORY SCALE SPRAY DRYING AND CONTINUOUS PROPAGATION OF *SERRATIA MARCESCENS*

(Publication No. 20,625)

Karl Russell Guenther, Ph.D.
The University of Wisconsin, 1957

Supervisor: Professor Marvin J. Johnson

A procedure has been worked out for the spray drying of *Serratia marcescens* on a laboratory scale. The cells used in this work were grown on a medium containing S^{35} , and total cell counts, for determining per cent survivals of the dried cells, were determined from the radioactive counts of the product and feed. The product was collected on a soluble filter in order to facilitate the removal of the cells from the filter.

Aerobic aging, prior to drying, has been shown to improve the viability of *Serratia*. The beneficial effect of using nitrogen and carbon dioxide as drying gases has also been demonstrated.

Addition of a diluent to the cell suspension prior to drying, improves survival, and is absolutely essential if the cells are to be stored for prolonged periods.

A pilot plant apparatus has been constructed to grow *Serratia* continuously.

Feed and withdrawal rates, pH control and addition of anti-foam are all electronically controlled. The fermentor itself is designed to operate at varying agitation rates and aeration efficiencies.

Steady state conditions have been maintained for 42 and 48 hours. In the former case, the production rate was 3.2 grams of dried cells per liter per hour with a 33.3% yield of cells from glucose. In the latter case, the aeration efficiency of the fermentor was increased, and the production rate was 4.3 grams of dried cells per liter per hour with a yield of 41%. 50 pages. \$2.00. Mic 57-1898

IN VITRO AND IN VIVO LOCALIZATION STUDIES WITH ANTILYMPHOBLASTOMA AND ANTI-EHRlich TUMOR ANTIBODIES

(Publication No. 21,186)

Raymond Natsuo Hiramoto, Ph.D.
University of Michigan, 1956

The localization and biological effects of I^{131} and fluorescein isocyanate labeled antibodies to Gardner lymphoblastoma 6C3HED and Ehrlich ascites carcinoma were studied *in vivo* and *in vitro*.

Antibodies were prepared in rabbits and their ability to protect against tumor cells was tested in inbred strains of mice. Heat inactivated serums gave limited protection. However when these serums were fortified with complement a structural change was observed in the tumor cells and protection at higher serum dilutions was obtained. The agglutination titers of these serums did not always parallel the protection titers.

In vitro localization studies were carried out by labeling ammonium sulfate fractionated anti-lymphoblastoma globulins with I^{131} . These data indicated a slightly greater localization with the anti-serum than the normal serum controls. Cross reactions were noted between tumor, liver and spleen particulates. Similar studies using tumor antisera tagged with fluorescein showed marked cross reactions with kidney and lung tissues and some cross reactions with liver and spleen.

In vivo localization studies using radioactively labeled anti-tumor globulin, normal rabbit and guinea pig globulin gave essentially the same pattern of localization. Although the highest localization of serums as measured by tissue to blood ratio of radioactivity was noted in the tumor, the serum uptake was not immunologically specific. Using the fluorescein tagging technique, localization of immune and to a lesser degree normal globulin was detected in the glomeruli of the kidney. Sections of other tissues showed no apparent localization of the labeled antibody even when cross reacting antigens were known to be present as shown by *in vitro* procedures. Tumor cells could be made to fluoresce *in vivo* with tagged immune globulin, providing the cells came in direct contact with the circulating labeled antibody as demonstrated by injecting tumor cells intravenously followed by intravenous injections of tagged anti-tumor serum. 112 pages. \$2.00. Mic 57-2049

STUDIES ON THE NUTRITIONAL REQUIREMENTS OF *BACILLUS COAGULANS*

(Publication No 21,064)

Thomas William Humphreys, Ph.D.
Michigan State University, 1956

A study was made of 177 spore-forming bacteria isolated from the wash waters of Canadian tomato juice packing plants. Only about 30 percent of these were able to produce flat-sour spoilage in tomato juice both aerobically and anaerobically. The remaining 70 percent grew only aerobically, generally producing thick cheesy pellicles and alkaline reactions. Since all organisms grew well on thermoacidurans agar (Difco)(DTA), it was concluded

that routine bacteria counts on this medium do not provide a true index of spoilage possibilities. Results indicated that the addition of 0.004 percent bromcresol green indicator to DTA, and increasing its dextrose concentration to 1.0 percent, rendered it more valuable as a plating medium. The significant acid-producing types were readily distinguished in this modified medium.

Taxonomic studies showed that *Bacillus coagulans* predominated among those organisms producing acid whereas those producing a more alkaline reaction in tomato juice resembled *Bacillus subtilis*.

The vitamin and amino acid requirements of 15 of the canning plant isolates identified as *B. coagulans* and 8 other authentic strains of this organism were studied at 37°C. In a medium comprising vitamin-free acid hydrolyzed casein, yeast extract, glucose, and mineral salts, growth occurred earlier at pH 5.5 than at 7.5. Substitution of malate, succinate, fumarate or citrate for glucose in this medium indicated that citrate was not utilized and response to the other three was feeble. Sporadic results obtained in this medium when vitamins were substituted for yeast extract did not result from a deficiency of cysteine or tryptophan. The variation was eliminated by substituting enzymic casein hydrolysate for the acid hydrolysate. Biotin and thiamin were required by all strains in this semi-synthetic medium. Niacin, also, was required by one strain, and folic acid by another. An additional requirement for folic acid (or PABA) was noted for most strains in a synthetic medium containing 12 amino acids. This was the most important difference between results obtained using the semi-synthetic medium and the synthetic.

The amino acid requirements were generally non-specific at 37°C. However, glutamic acid appeared essential for a few strains and stimulated others.

The enhanced growth generally afforded by the enzymic casein hydrolysate was largely a reflection of buffering action resulting from its high acetate content. Phosphate buffer appeared more favorable for *B. coagulans* since one strain proved acetate sensitive.

87 pages. \$2.00. Mic 57-2062

A STUDY OF VARIOUS METHODS FOR THE ENUMERATION OF ENTEROCOCCI IN RIVER WATERS AND SEWAGE

(Publication No. 20,210)

Karl Kereluk, Ph.D.
Michigan State University, 1956

A drop plate technic was introduced and a specific medium for growing typical and atypical enterococci was developed. The formula for this medium was as follows:

Ingredient	Grams per liter
Phytone	20.0
Lactose	5.0
Sodium chloride	5.0
Sodium azide	0.4
Yeast extract	5.0
Ethyl violet	0.00083
K ₂ HPO ₄	2.7
KH ₂ PO ₄	2.7
Agar	15.0

pH - 7.0

Sterilized at 121 C for 15 minutes

Samples of river and sewage waters were tested by a most probably number procedure, drop plate, and the membrane filter. The drop plate method detects more enterococci than by any method used, however, the method has its limitations in that it is effective only in examination of high population waters.

The membrane filter method serves amply where the limitations of the drop plate method begin. A modified ethyl violet azide medium for the enumeration of enterococci for use with the membrane filter technic was introduced.

76 pages. \$2.00. Mic 57-1899

OBSERVATIONS ON THE BRUCELLA ABORTUS INFECTION IN THE BOVINE

(Publication No. 21,482)

Nelson Byron King, Ph.D.
The Ohio State University, 1957

In spite of the fact that much progress has been made in the control and eradication of brucellosis over the past fifty years, there remain many unsolved problems. It was the purpose of the investigation to broaden the present scope of knowledge and to contribute to the solution of these problems.

Brucella M vaccine was injected into blood agglutination test negative cattle located in 12 privately owned dairy herds to determine its value as an immunizing agent against brucellosis.

Of the 487 animals that were negative to the sero agglutination test at the time of the injection of the vaccine, 23.4 per cent became reactors and 8.8 per cent aborted or calved prematurely during the subsequent 24-month observation period. During the same period, 36.9 per cent of the 60 unvaccinated controls became reactors and 27.4 per cent aborted or calved prematurely. The experimental data showed that the use of Brucella M vaccine produced a measurable degree of resistance to a field exposure of virulent Brucella organisms.

The results obtained in the experiment in which the injection of Brucella strain 19 vaccine was used as a means for differentiating vaccinal from infection sero agglutination titers indicated that the test was neither practical nor accurate enough to assist materially in the present brucellosis control program.

Paper-strip electrophoresis with an experimental-type horizontal cell was found to be a reliable method for the characterization of the proteins of bovine serum.

The data show that differences occurred in the serum globulins between the Brucella strain 19 vaccinates and the Brucella infected animals. The gamma globulin values of the infected group ranged from 51 to 65.3 per cent, while the vaccinated groups exhibited values of 36.7 to 52.1 per cent. The clear-cut differences indicated the feasibility of using this method as a possible differential test. The data suggest further work.

Considerable fluctuation of Brucella sero agglutination titer was noted when 23 Brucella vaccinated and unvaccinated cattle were injected with several types of hemorrhagic septicemia biologicals. The titer-rise was sufficient to cause the reclassification of four animals. It appeared that the injection of the antigens may have

influenced the concentration of sero agglutinins. However, these data seem to pose the question of whether the change in titer was due, in some way, to the injection of the antigens or whether it was no more than was usually found in the fluctuation of titers of *Brucella* vaccinated and infected individual animals.

Temperatures were recorded in a covered cement pit containing manure and bedding from 15 adult cattle during the filling period and for at least two weeks thereafter. The maximum pit temperature recorded during a summer period of observation was approximately 170° F., while the maximum observed during a comparable period during the winter months was 158° F. These maximum readings were usually reached seven to ten days after the filling process began. The temperatures remained near the maximum levels for about a week, then slowly declined until at the time of emptying the recordings were found to be approximately 20 to 25 degrees lower than the maxima.

Broth cultures of *Br. abortus* were found to be nonviable when examined four hours after being placed in the pit near the recording thermometer.

Various therapeutic agents were used on cattle shedding *Br. abortus* in their milk. A temporary cessation of the shedding was noted in most treated animals. However, recurrent infection was noted in all animals in which studies were complete. 193 pages. \$2.55. Mic 57-1900

PROPERTIES OF BACTERIAL FLAGELLA

(Publication No. 21,311)

Jack Noll Rinker, Ph.D.
Purdue University, 1957

Major Professor: Henry Koffler

Flagella of *Bacillus subtilis* 712 and *Proteus vulgaris* were isolated and formed into compressed monomolecular layers from spread surface films. Actomyosin was also isolated from the Psoas muscle of a rabbit and formed into similar compressed monomolecular layers (fibers). Each fiber in turn was weighted with a glass weight and suspended from a glass hook in pH 7.0-7.4 phosphate buffer (0.05M). Contraction of the actomyosin fibers was obtained upon the addition of 0.3 percent adenosinetriphosphate (ATP, sodium salt in dilute phosphate buffer, pH 7.0), followed by relaxation when a 0.1 M KCl solution was substituted for the ATP. No response could be obtained with fibers of flagella, although conditions were varied over a wide range of pH values, buffer types, molarity of ions (K, Mg, Ca), and concentration of ATP. Superprecipitation was also obtained upon the addition of ATP to dilute solutions of actomyosin (in 0.05, 0.1, 0.2 M KCl). No such reaction could be obtained with solutions of flagella when tested over a wide range of potassium ion and ATP concentrations. Electrical stimulation experiments were also performed on fibers of flagella by connecting them across the leads of the secondary winding of an induction coil. The fibers were surrounded by a variety of solutions (Ringer's perfusion fluid, Tyrode's perfusion fluid, phosphate buffer of different pH values and molarities, buffer with different concentrations of K, Mg, Na and Ca added). No response was obtained in these experiments.

During experiments preliminary to the isolation of flagella, it was noticed that under certain conditions the greatest number of flagella per cell occurred in the maximum stationary phase.

Amino acid analyses were performed by ion exchange chromatography with polystyrene resin (Dowex 50) according to the method of Moore and Stein. For these analyses, purified preparations of flagella from *Proteus vulgaris* were used. Such preparations normally contained 16 percent nitrogen, <0.001 percent carbohydrate, <0.01 percent ash, <0.01 percent "pH 2 insoluble" material and a single N-terminal (alpha-NH₂) amino acid (alanine). The data obtained from these analyses are listed in the table.

The amide nitrogen was arbitrarily assigned to asparagine, and subtracted from the total aspartic acid to obtain the free aspartic acid. From these data the molecular weight was calculated to be 34,600.

It is postulated that the protein in question has the following empirical formula: Thr₂₈ Ser₂₂ Glu₃₂ Gly₂₈ Ala₃₆ Cys₁ Val₂₁ Met₂ Isoleu₁₈ Leu₂₈ Tyr₄ Phe₈ Lys₁₆ Asp_{ine}₄₈ Asp₇ Arg₁₃. The molecule itself seems to contain 31 cationic groups, 39 anionic groups, 56 non-ionic groups, 139 non-polar groups or a total of 265 groups.

The main characteristics are an absence (or very low amount) of proline, histidine, and tryptophane; small amounts of cystine-cysteine; a relatively high value for threonine; and the fact that the aspartic acid-glutamic acid ratio is the reverse of that ratio for other proteins.

	Analysis grams per 100 grams of protein	Composi- tion grams per 100 grams of protein	At. Wts.* or Moles per 10 ⁵ grams of protein	Amino acid residues grams per 100 grams of protein
1 Total nitrogen		16.0		
2 Amide nitrogen		1.9		
3 Guanidine nitrogen		1.5		
4 ε-amino nitrogen		0.6		
5 Non alpha amino nitrogen (2 + 3 + 4)		4.0		
6 α-amino nitrogen		12.0	858	
7 Aspartate	20.7			
8 Threonine	9.6	9.6	80.6	8.2
9 Serine	6.7	6.7	63.7	5.6
10 Glutamate	13.6	13.6	92.4	11.9
11 Glycine	6.1	6.1	81.2	4.6
12 Alanine	9.3	9.3	104.4	7.4
13 Cystine	0.7	0.7	2.9	0.6
14 Valine	7.1	7.1	60.6	6.0
15 Methionine	1.0	1.0	6.7	0.9
16 Isoleucine	6.9	6.9	52.6	6.0
17 Leucine	10.6	10.6	80.8	9.2
18 Tyrosine	2.1	2.1	11.6	1.9
19 Phenylalanine	3.8	3.8	23.0	3.4
20 Lysine	6.7	6.7	45.9	5.9
21 Amide ammonia	2.3			
22 Arginine	6.4	6.4	36.7	5.7
23 Asparagine (calc. from 2)		17.9	135.5	15.5
24 Free aspartic acid (7 - 23)		2.8	21.0	2.4
Totals	113.6		899.6	95.2
25 Water of hydrolysis of asparagine			135.5	
Total			1035.1	
26 Water taken up during hydrolysis			1022	18.4

Amino acid composition of flagella from *Proteus vulgaris*.

*Applies only to alpha amino nitrogen.

94 pages. \$2.00. Mic 57-1901

THE EFFECTS OF DRYING, STORAGE AND REHYDRATION ON *SERRATIA MARCESCENS*

(Publication No. 20,649)

John Wesley Ross, Sr., Ph.D.
The University of Wisconsin, 1957

Supervisor: Professor E. M. Foster

A quantitative study was made of: (1) the behavior of spray dried *Serratia marcescens* during storage; (2) the effect of various rehydration solutions and conditions on the viable count of dried cells; and (3) physiological changes induced in the cells by spray drying.

The dry cells used in this study were prepared by suspending freshly grown cells in a solution containing two per cent dextrin and one per cent ascorbic acid; then drying the suspension in a pilot scale spray dryer.

Heat and moisture in the storage environment increased the death rate of the cells. The death rate of dried cells rehydrated in 0.1 per cent peptone solution was logarithmic and was separated into two parts: an initial relatively low rate followed by a faster death rate. Moisture and temperature in the storage container influenced the time at which the death rate changed and the extent to which it changed. Rehydration of stored dried cells in 0.01 M phosphate solution yielded viability curves that started at the same level as the standard (0.1 per cent peptone) curve but, dropped below and then rose above the standard curve as storage time increased. These results indicated that during storage dry cells underwent changes that were reflected in the reaction of the cells to rehydration in different solutions.

Investigation of physiological changes induced in cells by drying showed that oxygen uptake activity of dried cells always was greater than viability. That is, cells apparently dead as judged by the plate count procedure still were able to respire. Drying caused either no change or an increase in the respiratory quotients of cells on a variety of substrates. Arrhenius plots of oxygen uptake by feed and product cells revealed differences that were associated with changes in the internal environment of the cells. These results suggested that drying inactivated enzymes and caused disorganization of cell metabolic processes. It was concluded that disorganization of certain unidentified metabolic processes in cells was responsible for their inability to grow after drying.

109 pages. \$2.00. Mic 57-1902

CHARACTERIZATION OF THE PURINES AND PYRIMIDINES OF DEOXYRIBOSE NUCLEIC ACID FROM *MICROCoccus lysodeikticus* AND BACTERIOPHAGE

(Publication No. 20,843)

Joseph Victor Scaletti, Ph.D.
Cornell University, 1957

The purine and pyrimidine composition of the deoxyribonucleic acids of microorganisms and bacteriophage involved in abortive infection have been reported.

Deoxyribonucleic acids have been isolated from

Micrococcus lysodeikticus strain 1 and *Micrococcus lysodeikticus* strain 53-20. Using paper chromatography the purine and pyrimidine compositions of these nucleic acids have been determined qualitatively and quantitatively.

Adenine, guanine, cytosine and thymine are present in the nucleic acids from the two microorganisms. The DNA of ML 1 and ML 53-20 contain a concentration of guanine and cytosine greater than adenine and thymine and are therefore classed as a "GC" type.

Analysis of the nucleic acids of intact N1 bacteriophage, hot TCA extract of N6 bacteriophage, and TCA extract of the abortive lysate show differences in the composition of the bases adenine, guanine, cytosine and thymine which follow no known pattern.

A white fluorescent component was found in nucleic acids of N1, N6 and the abortive lysate, the last showing the highest apparent concentration. Its spectral characteristics at two different hydrogen ion concentrations and Rf values in two different solvent systems have been reported.

Because of the differences in base composition of the nucleic acids of N1, N6 and abortive lysate, it is suggested that a continuation of this work is desirable with highly purified DNA preparations from bacteriophages and abortive lysate.

It is suggested that the DNA synthesized during the abortive infection resembles N1 DNA with respect to the fluorescent component but differs with respect to the concentration of the bases cytosine and thymine.

47 pages. \$2.00. Mic 57-1903

STUDIES ON *PASTEURELLA PESTIS* AND SOME OF THE FACTORS INVOLVED IN CAPSULE ELABORATION

(Publication No. 21,498)

Gene Wheeler Schnell, Ph.D.
The Ohio State University, 1957

The need for an effective immunization against plague has been the concern of many workers since *Pasteurella pestis* was first isolated. The introduction of living avirulent organisms has been the most effective method but has not been widely accepted. Despite this, many workers are of the opinion that the immunizing capacity of various plague preparations for mice, rats, monkeys, and man is a function of its capsular (Fraction I or envelope) content.

A study was undertaken to develop a quantitative turbidimetric method to determine the amount of capsule produced by avirulent *P. pestis* A-12 and to use this assay procedure to investigate some of the factors which have an influence on the production of this material.

Lederle's anti-plague serum, adsorbed both with cells grown at 20° and a diluted supernatant fluid from a culture grown at 25°, was used in the assay of capsule material. Since very little capsular material is produced at 20° to 25°, non-capsular antibodies are removed by treatment of the antiserum with cells grown at these lower temperatures. To determine total soluble antigens, including capsular and somatic material, the unadsorbed anti-plague serum was used. A linear relationship was obtained between the optical density and the antigen concentration (purified Fraction IA) when samples contained from 0.5 to

3 μ g. After the reaction mixture was stored for approximately 24 hours in the cold, the turbidity was read at 500 m μ in the Beckman Model DU Spectrophotometer.

Variations in the concentrations of the sodium chloride and phosphate used in the diluent of buffered saline showed no adverse effects on the precipitin turbidity formation until the saline concentration was increased fourfold over the 0.85 per cent employed regularly. There was no significant variation in the turbidity readings when 10 different pH values ranging from 6.0 to 9.5 were tested.

Two methods of extracting capsular material were compared for their relative effectiveness and for determining the per cent of the total capsular material in solution after different periods of incubation. The extraction method of Englesberg and Levy with acetone-dried cells proved superior to the use of potassium thiocyanate as proposed by Amies. Approximately 60 per cent of the capsular material produced in 24 hours was in solution in the culture supernatant fluid, while at 36 hours the amount had increased to nearly 94 per cent.

The development of capsular material in a growing culture was optimal at approximately 37°, and its dependence on temperature was demonstrated by the fact that 250 times more capsular material was produced at 37° than at 25°.

In Englesberg and Levy's semi-synthetic medium, a carbohydrate source was necessary for capsular synthesis, and the optimal concentrations of glucose and xylose in this semi-synthetic and in Higuchi's synthetic medium were established. Glucose was most effective in the two media at 0.2 per cent, while xylose was optimal at 0.5-0.6 per cent with the semi-synthetic medium and at 0.8-1.0 per cent with the synthetic medium.

The rise in pH during growth was not an important factor influencing capsular production but very probably was a factor influencing solubility of the capsular material.

There were no marked differences in the rates of amino acid utilization by *P. pestis* at 25° and 37°. Supplementing the synthetic medium with amino acids known to be a part of the capsule did not result in any great enhancement of capsule elaboration. 93 pages. \$2.00. Mic 57-1904

THE CHARACTERISTICS OF TWO PHOSPHATASES FROM *PENICILLIUM CHRYSOGENUM*

(Publication No. 20,261)

William McLean Scott, Ph.D.
The University of Wisconsin, 1957

Supervisor: Dr. S. G. Knight

When mycelium of *Penicillium chrysogenum* NRRL 1951 B-25 was ground with sand or subjected to sonic disruption using an alumina abrasive, two phosphatases could be separated from the cell-free extracts by freezing and thawing several times, or by using dehydrating agents such as cold acetone. In addition to the cell-free phosphatase preparations, acetone-dried mycelial powders and whole cells were studied, in an attempt to educe the function of phosphatases in the mold.

The two phosphatases had different pH characteristics, although the apparent optimum pH of a phosphatase *in vitro*

depended on the nature and concentration of the substrate and buffers, as well as on the amount of aeration during growth of the mycelium, and probably was influenced by some unidentified factors in the medium. The phosphatases are stable enzymes, stimulated by magnesium, although the magnesium stimulation decreases as the phosphatase is purified, until the effect of magnesium becomes negligible. Complete inhibition was obtained with iodoacetate and tetraethyl pyrophosphate, but only at concentrations which would be very inhibitory to a number of other enzymes. Fluoride inhibition was incomplete at all concentrations up to 2 molar.

The phosphatases transferred phosphate to glucose, ribose and xylose, to form glucose-1-phosphate and pentose phosphates.

Washed whole cells released orthophosphate into the medium, and much of that orthophosphate must have resulted from the hydrolysis of phosphate esters in the mycelium. Washed resting cells also absorbed orthophosphate from the medium which contained sugars.

It is suggested that phosphatase, as synthesized by the mold, is attached to a protein matrix to prevent random hydrolysis of important phosphate esters in the cell; however, the mold must be able to free the phosphatase from the other protein and release the phosphatase into the medium, because the freed ("soluble") phosphatase appeared in the medium at an earlier hour than the attached ("precipitable") phosphatase which probably appeared only after autolysis of the mycelium. The freed phosphatase would have some properties different from those of the attached enzyme, but they would be similar enzymes.

113 pages. \$2.00. Mic 57-1905

QUANTITATIVE STUDIES ON THE PHENOMENON OF SURFACE PHAGOCYTOSIS

(Publication No. 21,234)

Robert Elwin Weaver, Ph.D.
The University of Wisconsin, 1957

Supervisor: Professor C. V. Seastone

The term surface phagocytosis was first used by W. B. Wood and his co-workers to describe the method by which encapsulated organisms were phagocytized in the absence of antibody. Discovery of this method of Phagocytosis was made while studying the pathogenesis of pneumococcal pneumonia in rats. Before this it was believed that encapsulated pneumococci were resistant to phagocytosis except in the presence of specific antibody.

Further published studies have attempted to characterize surface phagocytosis and establish its value in natural immunity. Few of these have been determined in a quantitative way. Some other workers have not been able to reproduce Wood's findings and have raised questions as to their validity. The present experiments are an attempt to clarify some of these points.

Fibrin of clotted human blood was used as the source of a surface in these experiments. The pneumococcus type I and 3 strains of streptococci were examined. Organisms were added to blood in the pre-clot stage. After an incubation period phagocytic counts were made and

compared to controls of heparinized and defibrinated blood. By making plate counts after grinding the clots in tissue grinders, bactericidal activity of surface phagocytosis was also studied. These systems were also used to determine the effect of specific antiserum and bacteriostatic levels of penicillin on surface phagocytosis.

The results confirm the previous reports that the presence of fibrin made it possible for encapsulated organisms to be phagocytized in the absence of antibody. Bacteriostatic levels of penicillin made it easier to demonstrate bactericidal activity. Evidence is presented that levels of penicillin having little bacteriostatic activity in heparinized blood increase the bactericidal activity of clotted blood. Under varying conditions fibrin clots may either interfere with or increase the bactericidal power of specific antibody.

These findings support Wood's views on surface phagocytosis. However, its importance in natural immunity seems difficult to evaluate. There is a need for more in vivo experiments to help in this evaluation.

64 pages. \$2.00. Mic 57-1906

STUDIES ON THE MECHANISM OF ADSORPTION OF NEUROTROPIC VIRUSES

(Publication No. 21,377)

Frank Zago, Ph.D.
University of Michigan, 1956

The purpose of this study was to determine the physical and chemical factors involved in the adsorption of certain neurotropic viruses on cells, in order to contribute to an understanding of the mechanism of infection of animal virus-host cell systems.

Ion exchangers and cells were used to study adsorption of Eastern equine encephalomyelitis (EEE) virus and Novy rat virus (NRV). Ion exchangers provided a synthetic system by means of which the role of physical forces on virus adsorption could be evaluated. Since the chick embryo is susceptible to these viruses its tissue was considered a satisfactory source of cells. A suspension of cells was prepared by treating chick embryo fragments with ethylene diamine tetraacetate. Ehrlich ascites tumor cells readily obtainable in suspension as single cells were also used.

At pH 7.4, adsorption of NRV on a carboxylic exchanger was directly proportional to the concentration of cations in solutions from 0.01 to 0.2 molar. Calcium and magnesium

ions were more effective in promoting adsorption of NRV and EEE virus than were sodium or potassium ions. Adsorption did not occur in the absence of electrolytes. Similar results were obtained in solutions of chlorides and phosphates of sodium and potassium suggesting that anions do not play an essential role in virus adsorption. No evidence was obtained to indicate that these viruses require multivalent cations or organic cofactors for adsorption, although in solutions of low electrolyte concentration valine enhanced adsorption of NRV on the exchanger. Approximately 50 per cent of adsorbed virus was recovered by treating the carboxylic exchanger with water. Methylation of the exchanger destroyed its ability to bind virus. EEE virus did not adsorb in saline at pH 10.4; at pH 9.6 adsorption was 50 per cent of maximum.

Virus adsorption on a quaternary amine exchanger was inhibited by electrolytes; $MgCl_2$ was a more effective inhibitor than were sodium salts.

Adsorption of EEE virus on chick embryo cells was independent of temperature. Adsorption occurred in solutions of sodium and potassium salts and did not occur in isotonic solutions of $CaCl_2$, $MgCl_2$ and maltose. Adsorbed virus was eluted in solutions of $MgCl_2$, $CaCl_2$ and maltose.

Similar results were obtained with Ehrlich tumor cells except that elution did not occur in maltose solutions and virus eluted in solutions of electrolytes at 37 C. Elution of virus did not affect the viability or the ability of tumor cells to readorb virus.

Treatment of chick embryo and tumor cells with trypsin inhibited their ability to adsorb EEE virus; other enzymes were ineffective. EEE virus did not attach to a number of animal cells which were tested. Mucoproteins which are active against influenza virus did not inactivate EEE virus.

It was postulated that in order for these viruses to adsorb, the cell must possess an appropriate receptor and the suspending solution must contain electrolytes at a suitable pH. Cations reversibly adsorb on the negatively charged surface of the virus forming a virus cation complex which reversibly attaches to acidic groups by means of its ionized amino groups. The role of cations is to neutralize the acidic groups on the virus surface enabling the virus to approach a negatively charged surface. Isotonic solutions of $CaCl_2$ and $MgCl_2$ appear to inhibit by reversibly combining with acidic groups on the cell surface forming an undissociated complex. The site for adsorption of EEE virus appears to differ from the mucoprotein receptor of influenza virus and may be protein in nature. EEE virus spontaneously elutes from Ehrlich tumor cells apparently without destroying the adsorption site.

69 pages. \$2.00. Mic 57-1907

BIOLOGY-GENETICS

BIOLOGY-GENETICS

SELECTION FOR QUANTITATIVE CHARACTERS IN RATS: PART I: COMPARISONS OF THE PREDICTED WITH ACTUAL GAINS FROM SELECTION OF PARENTS OF INBRED PROGENY. PART II: INTERACTION OF EFFECTIVENESS OF SELECTION WITH DIFFERENT FEEDING REGIMENS.

(Publication No. 21,215)

Chin Sik Chung, Ph.D.
The University of Wisconsin, 1957

Supervisor: Professor A. B. Chapman

PART I. COMPARISONS OF THE PREDICTED WITH ACTUAL GAINS FROM SELECTION OF PARENTS OF INBRED PROGENY

Selection for high or low ovarian response to a standard dose of a gonadotrophic hormone was practiced in the rat for different numbers of generations under mating systems involving inbreeding, outbreeding, and "crossbreeding". Comparisons were made between the actual and predicted gains from selection of parents within inbred progeny.

Selection of individuals was based on the average performance of their full-sisters. The predictions of the average ovarian responses of offspring were made from the averages of full-sisters of parents by use of a regression equation based on a heritability of .22 for individuals.

In general, good agreement was obtained between the observed and predicted averages. Over all generations and all mating systems, the average weights of the observed and expected were 79.3 and 79.6 mgs., respectively, from 157 matings for the high line. The comparable values for the low line were 55.9 and 56.5 mgs. based on 166 matings.

There was no conclusive evidence from the data that the degree of ovarian response was genetically correlated with litter size at birth, age and weight at vaginal opening.

PART II. INTERACTION OF EFFECTIVENESS OF SELECTION WITH DIFFERENT FEEDING REGIMENS

THE PRELIMINARY EXPERIMENT

Groups of rats with comparable genetic constitution were reared on (1) ad libitum feeding of an adequate protein diet, (2) $3/4$ and (3) $2/3$ restrictions in food intake of an adequate protein diet, (4) ad libitum feeding of diets whose protein contents were restricted to approximately (a) 16%, (b) 14%, (c) 12%, and (d) 10% for a period of six weeks from 3 to 9 weeks of age. The effects of these diets on growth rate and reproductive performance were studied as a preliminary to the main selection experiment.

A clear-cut differentiation was obtained among certain groups of diets in the rate of gain from 3 to 9 weeks of age with variability unaffected. The differences had become

relatively smaller after all animals were placed on diet (1) for 4 weeks. Viability of the animals was not influenced by the deficient diets, though all dietary restrictions delayed age at vaginal opening.

There was little, if any, evidence to indicate that the dietary restrictions affected the reproductive performance of the animals. However, the 3-week individual weights of young from the parents on the deficient diets were smaller than that of diet (1).

It was concluded that if two types of dietary restrictions were to be used, the $3/4$ restriction of food intake and a level of protein content between the 14% and 12% would be most satisfactory in the main experiment.

THE MAIN EXPERIMENT

Three groups of rats with similar genetic constitution were selected for rate of gain from 3 to 9 weeks of age for 3 generations under 3 feeding regimens: (1) ad libitum feeding of an adequate protein diet, (2) the restriction of food intake to $3/4$ of (1), and (3) the restriction of protein only to 13%. The relative effectiveness of selection within diets was examined here.

The realized heritabilities estimated on the basis of results of selection gave the values, .100 for diet (1), .083 for diet (2), and .169 for diet (3), indicating that slightly more rapid progress was made by selection under diet (3) than the other two. The difference was not, however, significant between diets (1) and (3).

141 pages. \$2.00. Mic 57-1908

FACTORS AFFECTING CAROTENE AND SUGAR FORMATION IN SWEET POTATOES

(Publication No. 20,611)

Abdel-Rahman Kotb Gaafar, Ph.D.
Louisiana State University, 1957

Supervisor: Professor Julian C. Miller

Studies were made on factors affecting carotene and sugar formation in sweet potatoes. These studies consisted of four main parts:

1. The effect of removing different amounts of leaves and stems on the carotene and sugar content of the sweet potato.
2. The use of grafting to ascertain whether or not there is any translocation of carotene in the sweet potato.
3. The effect of light on the carotene and sugar content of the sweet potato.
4. The effect of various storage conditions on the carotene and sugar content of the sweet potato.

There is a relationship between the amounts of leaves and stems formed by the sweet potato plant and the carotene and sugar content found in the roots, the larger the amount of leaves and stems removed the less the carotene and sugar content of the roots. The highest amount of either carotene or sugar was found in the roots of the untreated plants. However, the carotene and sugar contents in all treatments were not proportional to the amounts of leaves and stems removed.

Different grafting procedures were done. An original method of grafting, i.e. grafting stems on roots, was successful. Grafting experiments showed that there was no translocation of carotene either from the stems to the roots or vice versa. Accordingly, the carotene is synthesized in the plant organs where it is found.

Light increased both the carotene and the sugar content in the roots of the studied varieties of sweet potatoes. Intervals of storage after harvest also increased the carotene and sugar content of the sweet potato. Various factors, including light, varieties and storage intervals after harvest were studied in detail.

The effect of various storage conditions on the carotene and the sugar content of different varieties of sweet potatoes was studied in detail. In all these experiments increasing the length of the storage periods did increase the carotene and sugar content in the roots of the varieties of sweet potatoes used. Roots stored at 55° F had the highest sugar content. Those stored in common storage had the lowest sugar content. The lower the storage temperature the more sugar the sweet potato roots contained. In case of the carotene the effect of storage temperatures was not as consistent as in the case of the sugar content. The effect of various storage conditions, including all the possible combinations of storage periods, varieties, and storage temperatures was studied in detail. The results may be summarized as follows:

1. Roots of untreated plants of sweet potatoes had larger amounts of both carotene and sugar than plants from which various amounts of leaves and stems were removed.
2. Carotene was not translocated from the stems to the roots or vice versa.
3. Light increased both the carotene and the sugar content in the roots of sweet potatoes.
4. Carotene and sugar content of sweet potatoes increased throughout storage.
5. Under the conditions of these experiments sweet potatoes stored at the lowest temperature used (55° F) had the highest sugar content. In the case of carotene, the effect of storage temperatures was not consistent. However, there was an increase in both the carotene and the sugar content throughout storage periods regardless of the storage temperatures.

All the data in these studies were calculated on dry weight basis and analysed statistically by means of the analysis of variance procedure.

106 pages. \$2.00. Mic 57-1909

AN INVESTIGATION OF AN HEREDITARY MELANOTIC TUMOR IN *DROSOPHILA* *MELANOGASTER*: tu^{51f}

(Publication No. 21,247)

Ronald Avron Kroman, Ph.D.
University of Minnesota, 1957

An investigation was made of the biology of an hereditary melanotic tumor, tu^{51f} , which was observed in an ebony¹¹ strain of *Drosophila melanogaster*. The tumors develop by blood cell aggregation during the larval stages, and pigment is deposited in the tumors in the late pupal stage. The tumor incidence is easily modified by inbreeding and selection, and lines with mean tumor frequencies over 80% and less than 10% were produced after 4 to 5 generations of selection.

The tumor incidence has been shown to be related to maternal age, and the mean tumor frequency of offspring of young mothers (less than 9 days old) is significantly less than the frequency of offspring from mothers 9 days old or older. As a result of the relationship between maternal age and tumor incidence and the greater fertility of the younger females, the first F_1 flies to emerge in a culture have the lowest tumor incidence. The incidence rapidly increases, reaching a maximum in the F_1 emerging on the 3rd or 4th days, and gradually declines until the F_2 flies begin to emerge.

The tumor frequency of one line of tu^{51f} , which was 30% when the flies developed at 21° C., decreased to less than 10% when the flies developed at 26° C. and increased to over 90% when they developed at 16° C. An attempt was made to determine whether the change in tumor frequency induced by higher or lower developmental temperatures was confined to a particular stage of development by transferring flies at successive stages of development from 21° C. to 26° C. and to 16° C. to complete their development. A period of sensitivity to higher developmental temperatures was found at the end of the larval stages. No definite period of sensitivity to lower developmental temperatures was observed, the tumor frequency in the adults being inversely proportional to the length of time the flies developed at the lower temperature. Flies developing at 16° C. after the mid-pupal stage had a significantly lower tumor frequency than the controls. A determination of the number of flies developing in the groups transferred has indicated that selection cannot account for the temperature-induced changes in tumor incidence. The fact that the lower developmental temperature can cause a significant reduction in tumor incidence when applied in the pupal stage, when the aggregative phase of tumor formation has been completed but the pigment has not yet been deposited, suggests that the reduction is an apparent one that is due to an inhibition of tumor pigmentation. Evidence from other experiments suggests that other temperature-induced changes in tumor frequency are also due to effects on tumor pigmentation and not due to an enhancement or inhibition of blood cell aggregation.

The addition of the alkaloid colchicine and the antibiotic aureomycin to the culture medium had no effect on either tumor frequency or morphology, although aureomycin improved culture conditions as indicated by an increase in the number of successive generations of flies developing in the treated cultures as compared to the controls.

Tu^{51f} is caused by four major genes: two, which are

semidominant in their action, are located on the second chromosome, one between 33 and 38 units and the second between 91 and 94 units; and two, which are completely recessive in action, are located on the third chromosome, one at ca. 34 units and the second between 80 and 83 units. Modifying factors have also been found on the first and fourth chromosomes. A number of common laboratory strains, both mutant and wild type, contain factors which inhibit or enhance tumor frequency.

138 pages. \$2.00. Mic 57-1910

THE EFFECT OF DDT IN THE PRODUCTION OF TOLERANT AND SENSITIVE STRAINS OF THE HOUSE FLY (*MUSCA DOMESTICA* L.)

(Publication No. 20,885)

Ayyadevara Venkata Krishna Mohan Rao, Ph.D.
University of Illinois, 1957

Introduction

Perry and Hoskins (1950) and Sternburg et al. (1950) have independently reported the ability of resistant house flies (*Musca domestica* L.) to metabolize DDT (1,1,1-trichloro-2,2-bis(p-chlorophenyl)ethane) into non-toxic metabolite DDE (1,1-dichloro-2,2-bis(p-chlorophenyl)ethylene). In 1953, Sternburg et al. discovered the presence of an enzyme in resistant flies capable of metabolizing DDT to DDE *in vitro* and named it "DDT-dehydrochlorinase."

Several studies have been made which indicate that treatment with sublethal dosages of DDT have, presumably, sensitized the insects (Hoffman et al. 1951; Beard, 1952; Chang and Crowell, 1953; and Taher, 1956).

Thus, the above studies have emphasized two problems: (1) The correlation between degree of resistance and ability to dehydrochlorinate DDT after successive generations of selection and (2) the effect of continued exposure of larvae to sublethal dosages of DDT on the sensitivity of successive generations.

Results and Discussion

A. Production of Resistance.

Duplicate experiments were made to produce resistance in a susceptible strain of house flies by treating the larval medium with DDT sufficient to kill approximately 80 percent of the larvae of each generation. After nine consecutive generations resistance to DDT had risen approximately 20-fold. A comparison between the percentages of larvae pupating in the treated and untreated medium of the test strains showed that (1) the vigor and viability of the larvae from the untreated medium of the test strains and the larvae of the CSMA (susceptible) strain cultured in untreated medium were similar and that the mortality of larvae obtained in the treated medium of the test strain was due to the lethal action of DDT.

The increase in resistance in the test strains was measured by two criteria, viz., LD-50 values (median lethal dosages) and the ability of flies to dehydrochlorinate DDT enzymatically. The results show an initial phase for four or five generations in which the flies showed no resistance, and in fact there was some evidence of partial

sensitization, as measured by LD-50 values and the total absence of DDT-dehydrochlorinase activity. There was slight but insignificant increase of resistance in the fifth generation. But from the sixth to the ninth generation there was an appreciable and rapid increase in resistance as measured by both the criteria. This suggests that resistance develops as the result of selection of individuals having the ability to synthesize the enzyme, DDT-dehydrochlorinase.

B. Effect of sublethal dosages of DDT applied in larval medium.

In experiments designed to study the effect of sublethal dosages of DDT, applied in larval medium, three sets of dosages were used on successive generations of larvae, viz., 2 PPM (parts per million), alternation of 2 PPM and 5 PPM, and 5 PPM. The results indicated that treatment of larvae of successive generations either with 2 PPM of DDT or alternating 2 PPM and 5 PPM of DDT, have diminished the ability of larvae to reach the pupal stage. At the dosage of 5 PPM of DDT only a slight and possibly insignificant effect of this sort was detected.

It was observed that treatment of the larval medium with 2 PPM of DDT, resulted in a sensitive strain of house flies which were about three to four times more susceptible to DDT than the parent CSMA strain. Alternating 2 PPM and 5 PPM of DDT the sensitivity of the strain was only one-and-a-half times that of the parent CSMA strain. However, treatment of larval medium with 5 PPM has resulted in a slightly resistant strain of house flies.

Similar experiments in which 2 PPM and 5 PPM of DDT were used, in separate experiments, to treat the larval medium of successive generations of a resistant strain, failed to affect either the vigor and viability of the larvae or to decrease the resistance of the strain to DDT.

Thus, by using the proper dosage level of DDT in the larval medium strains of flies either tolerant or sensitized to DDT were produced. A corollary to the development of a DDT-sensitive strain would appear to be a diminished ability of the larvae to develop to the pupal stage.

Summary

1. A study was made to determine the effect of increasing dosages of DDT applied in the larval medium upon the resistance of succeeding generations to the compound.

2. LD-50 values and the ability of flies to dehydrochlorinate enzymatically were taken as criteria to measure resistance. There was slight decrease in median lethal dosage for the first five or six generations, in which no enzymatic activity was noticed.

3. The strains of flies showed rapid development of resistance from the fifth or sixth generation to the ninth, measured both by the increase in LD-50 values and by the enzymatic dehydrochlorination of DDT.

4. There was a highly significant correlation between the increase in median lethal dosage and in DDT-dehydrochlorinase activity. Therefore, it was concluded that increase in resistance is associated with the increased production of the enzyme.

5. The effect on the CSMA strain of treating larval medium with sublethal dosages of 2 PPM of DDT, alternating 2 PPM of DDT and 5 PPM of DDT, and 5 PPM of DDT alone, was studied in each successive generation for ten generations. All the treatments decreased the percentage of pupation from the first to the tenth generation.

6. When a dosage of 2 PPM of DDT was used in the larval medium, one strain of flies became four times more susceptible and another three times more susceptible than the parent CSMA strain in ten generations.

7. When a dosage of 2 PPM and 5 PPM of DDT were alternated in successive generations, the strain became only 1.6 times more susceptible than the parent CSMA strain in ten generations.

8. When a dosage of 5 PPM of DDT was used in the larval medium, there was a slight increase in resistance to DDT.

9. A resistant strain of house flies cultured in larval medium containing 2 and 5 PPM of DDT, retained their original level of resistance and the ability of the larvae to pupate was unaffected after ten generations.

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 52 pages. \$2.00. Mic 57-1911

BOTANY

THE TAXONOMIC POSITION OF THE GENUS
 MYCOSPHAERELLA AS SHOWN BY COMPARATIVE
 DEVELOPMENTAL STUDIES

(Publication No. 21,141)

Margaret Elizabeth Barr, Ph.D.
 University of Michigan, 1956

In recent years the classification of the higher Ascomycetes has been based largely on the type of development of the ascocarp. Many collections of Ascomycetes do not show all stages of development and it is often difficult to identify material. The purpose of this study was to determine if there is a correlation between the appearance of the mature ascocarp and its type of development. Special attention was paid to the genus *Mycosphaerella* and the variable species *M. tassiana*. In addition to a study of development, the history of the genus was traced.

The development of six species of Ascomycetes has been studied in detail. *Mycosphaerella tassiana* (de Notaris) Johanson, *M. typhae* (Lasch) Lindau, *Leptosphaeria typharum* (Desmazieres) Karsten, *Gelasinospora calospora* (Mouton) C. and M. Moreau, and *Phaeotrichum hystricinum* Cain and Barr were grown in culture and all produced ascocarps. *Limacina alaskensis* Saccardo and Scalia was studied from herbarium material. The ascocarps of the six species were sectioned, stained, and examined microscopically. The developmental type was determined for each species, and they were compared with one another at all stages.

The two species of *Mycosphaerella* studied, *M. tassiana* and *M. typhae*, are both ascostromatic forms and are typical of the Dothidea developmental type. They belong in the family Dothideaceae of the Dothideales. *Limacina alaskensis* is similar in development to the species of *Mycosphaerella*. The morphology of ascostromata and mycelium place it in the Capnodiaceae in the Dothideales. *Leptosphaeria typharum* produced pseudoparaphyses in the ascostromata as described for the *Pleospora* developmental type. It belongs in the family Pleosporaceae of the Pleosporales. *Gelasinospora calospora*, in contrast to the

four preceding species, showed ascohymenial development of the *Xylaria* type. It is a member of the Xylariales, family Xylariaceae. *Phaeotrichum hystricinum* was found to have the ascolocular development of the Loculoascomycetes and the unitunicate asci of the Euascomycetes. This combination of characters has not been previously reported, and constitutes what is believed to be a new developmental type, named the *Phaeotrichum* type. This type is considered to be characteristic of the family Phaeotrichaceae of the Eurotiales.

The conclusions obtained from this study are: (1) the development of the ascocarp and the structure of the ascus are together characteristics which provide ordinal separation; (2) the appearance of the mature ascocarp indicates in many cases the type of development through which it passed, and thus its position in the system of the Ascomycetes; (3) the genus *Mycosphaerella*, typified by *M. punctiformis* (Persoon ex Fries) Starbäck, may be divided into three subgenera, *Mycosphaerella*, *Didymellina*, and *Cymadothea*, on the basis of morphological characteristics; (4) the variable species, *Mycosphaerella tassiana*, may be separated into five forms on the basis of morphology.
 207 pages. \$2.70. Mic 57-1912

THE FLORA OF SOUTHEASTERN IOWA

(Publication No. 20,920)

Robert Austin Davidson, Ph.D.
 State University of Iowa, 1957

Chairman: Associate Professor Robert F. Thorne

This paper culminates an attempt to bring up to date our knowledge of the vascular flora of the southeastern corner of the State of Iowa. The counties comprising this area are: Appanoose, Davis, Des Moines, Henry, Jefferson, Keokuk, Lee, Louisa, Mahaska, Monroe, Muscatine, Van Buren, Wapello, and Washington.

For the preparation of this Flora the author has collected, identified, and labeled nearly four thousand five hundred numbers totaling an estimated nine thousand plant specimens. An undetermined, but larger, number of herbarium specimens have been carefully checked and annotated. Herbaria which contributed these specimens are: State University of Iowa, Iowa State College, Parsons College, Iowa Wesleyan College, and Davenport Public Museum.

Appropriate recent literature has been utilized in the application of names and the clarification of species delimitations. Within the limits of materials and time, the author has attempted tentatively to resolve problems apparent in certain difficult taxa. Taxonomic notes are given in such cases. Attention is given to specimens which display evidence of possible hybridization or otherwise seem atypical.

The literature of the flora of southeastern Iowa has been used to trace herbarium specimens and to build a workable synonymy. Species which have been reported but for which no voucher specimen has been seen are not considered a part of the flora but are dealt with in a separate section of the paper.

A map has been prepared for each species showing locations where specimens have been collected or observed.

The number of species, considered valid by the author, currently known for southeastern Iowa is 1251. Of this number 1004 are considered indigenous. A total of 124 families are represented by the flora.

763 pages. \$9.65. Mic 57-1913

STUDIES IN THE NORTH AMERICAN SPHAGNACEAE

(Publication No. 21,358)

Irma Schnoberger, Ph.D.
University of Michigan, 1956

The main purpose of this study is to illustrate and briefly describe the species and varieties of *Sphagnum* found in North America.

Part I contains an historical sketch of the development of taxonomic concepts of this family. A discussion of techniques for preparation of mounted specimens for observation is followed by an illustrated glossary, a key to the species and varieties, a brief description of each and a set of plates illustrating those found in North America.

Part II is a study of the application of statistics to two species of *Sphagnum* in an effort to ascertain the range of variations in some characters of *Sphagnum* and the differences in their means between the two species studied.

Slides previously made from one plant from each of 25 collections of *S. magellanicum* and from 13 of *S. papillosum* were used. From the slide of each plant pore numbers were counted from cells of four different areas: On the basis of the material studied pore count of sufficient contiguous stem cortical cells is useful in separating the two species; the comparison of number of pores in branch cortical cells is not valuable in separating them; the best pore count differentiation is found in number of pores on inner walls of contiguous hyaline cells from the most concave region of a typical branch leaf; the pores on outer

walls of contiguous hyaline cells from the same region of branch leaves are also differential.

Comparison of plants of *S. magellanicum* collected from two different bogs in Michigan was made; They were not significantly differential.

An analysis of variance of spore size was applied to the differences between and within 7 specimens of *S. magellanicum* and 1 specimen of *S. papillosum*: The spores of the two species differ enough in size to be distinctive for each species, and when available are of value in separating them.

Statistical methods promise to be of much aid in the identification of the species of *Sphagnum*.

Part III is a comparison of measurements of the spores of *S. magellanicum* and *S. palustre* a) in water and b) in glycerine. The spores were mounted in water under a cover slip and allowed to stand for 24 hours, then their sizes were recorded. Glycerine was added to the slides and after 24 hours the spores were again measured. There is wide variation in the spore sizes in both instances, but they are consistently larger after standing in glycerine than when in water only. 184 pages. \$2.40. Mic 57-1914

FUNGITOXICITY AND PHYTOTOXICITY OF CAPTAN AND FUNGITOXICITY OF SOME OTHER COMPOUNDS CONTAINING THE N-(TRICHLOROMETHYLTHIO) GROUP

(Publication No. 21,091)

Gustave Silber, Ph.D.
Cornell University, 1957

An attempt was made to correlate the activity of N-(trichloromethylthio)-4-cyclohexene-1,2-dicarboximide (captan) with structural configuration by the comparison of the regression coefficients and ED 50 values of the dosage-mortality data of conidia of *Stemphylium sarcinaeforme* (Cav.) Wilts. and of *Fusarium sambucinum* Fückel to a number of N-(trichloromethylthio) imide and hydantoin derivatives. The dosage response of the conidia of the fungi to the tested materials was obtained by the test-tube dilution and slide-germination technique. Regression coefficients and ED 50 values of the toxicity curves were calculated by probit analysis of the data.

The tested N-(trichloromethylthio) imide derivatives were I) N-(trichloromethylthio)-3,6-endomethylene-cyclohexene-1,2-dicarboximide, II) N-(trichloromethylthio)-x-methyl-3,6-endomethylene-4-cyclohexene-1,2-dicarboximide, III) N-(trichloromethylthio)-4-methyl-4-cyclohexene-1,2-dicarboximide, IV) N-(trichloromethylthio)-o-benzoic sulfimide, V) N-(trichloromethylthio)-4-cyclohexene-1,2-dicarboximide, VI) N-(trichloromethylthio)-3,6-endomethylene-4-cyclohexene-1,2-dicarboximide, VII) N-(trichloromethylthio)-4,5-epoxy-cyclohexene-1,2-dicarboximide, and VIII) N-(trichloromethylthio)-cyclohexane-1,2-dicarboximide.

The tested N-(trichloromethylthio) hydantoin derivatives were IX) 3-(trichloromethylthio)-5,5-dimethyl hydantoin, X) 3-(trichloromethylthio)-5-methyl-5-ethyl hydantoin, XI) 3-(trichloromethylthio)-5-methyl-5-isopropyl hydantoin, XII) 3-(trichloromethylthio)-5-methyl-5-isobutyl

hydantoin, XIII) 1-acetyl-3-(trichloromethylthio)-5,5-dimethyl hydantoin, and XIV) 1-nitro-3-(trichloromethylthio)-5,5-dimethyl hydantoin.

Norsulfane XV), N-methylsulfon-N-(trichloromethylthio)-anilide, was also included in the tests.

In tests with both fungi, only compounds XIII and XIV of the hydantoin derivatives gave toxicity curves that differed from that of captan.

When the imide derivatives were tested against *Stemphylium*, compounds III, VII, and VIII gave toxicity curves that were the same as that of captan; the remainder of the imide derivatives gave toxicity curves that differed from that of captan. Norsulfane was also found to give a toxicity curve that differed from that of captan.

With *Fusarium* as the test fungus, only the toxicity curves of compounds VIII and XV differed from that of captan.

The majority of the imide derivatives were found to be more potent for the inhibition of germination of the conidia of *S. sarcinaeforme* than were the hydantoin derivatives except for compound XII, which was intermediate among the tested imide and hydantoin derivatives. Within the homologous series of hydantoin derivatives, toxicity to conidia of *Stemphylium* and *Fusarium* increased as substitution on the 5 position of the hydantoin moiety increased the number of carbon atoms in the aliphatic side chain from 1 to 4.

Spores of *Stemphylium* were given timed exposures to separate 10^{-4} M suspensions of compounds V, XII, and XIV. Fifty per cent inhibition of germination of the conidia was caused by compounds V and XIV after 120 and 20 minutes, respectively. Compound XII failed to inhibit 50 per cent of the spores after 24 hours.

In studies on uptake of compounds V, XII, and XIV by conidia of *Fusarium*, larger amounts of compound XIV were removed from the ambient fluid in a given short time (5-10 minutes) than of either of the other 2 compounds.

Captan and all the other compounds at 10^{-3} M were poor inhibitors of a purified carboxylase preparation *in vitro*; the hydantoin derivatives were, in general, better inhibitors of the enzyme than were the imide derivatives. Compounds XIII and XIV were the best inhibitors of the enzyme. Methylation of the ring portion of the cyclohexene portion of the captan molecule increased potency against the carboxylase system.

At 10^{-4} M, all compounds inhibited oxygen uptake of conidia of *Fusarium*, but the majority of the materials did not significantly differ from one another in their inhibiting ability at this concentration. With the tested compounds, there was no correlation between inhibition of spore germination and inhibition of oxygen uptake by conidia of *Fusarium*.

The growth of tomato, Red Kidney bean, corn, and peppermint plants in Hoagland's nutrient solution supplemented with 1-10 ppm of captan was less than that of control plants receiving no captan. Of the 4 kinds of plants tested, tomato was the most sensitive to the presence of captan.

The growth of tomato, Red Kidney bean, corn, cucumber, and cabbage plants that were grown from seed planted in fumigated soil to which captan had been added was inhibited by the presence of captan. The growth of tomato plants was affected by as little as 25ppm (basis of dry weight of soil) of captan and that of cabbage plants by 100 ppm of captan; in contrast, growth of corn or bean plants was not affected by concentrations of captan less than 400 ppm.

At concentrations that caused stunting, there was a slight marginal necrosis of cotyledons and leaves of tomato, cabbage, and cucumber plants. The roots of such plants were brownish in color and less extensive than those of the control plants.

The solubility of captan in deionized water at a temperature of 25-30°C, as determined by a bioassay and a chemical assay of the dialysate following equilibrium dialysis of a captan suspension, was found to be approximately 5-6 ppm.

115 pages. \$2.00. Mic 57-1915

A FUNGUS-LIKE STRUCTURE IN POTATO TUBERS AND POTATO TISSUE CULTURES

(Publication No. 21,235)

Donald Alcoe Young, Ph.D.
The University of Wisconsin, 1957

Supervisor: Professor G. H. Rieman

The tubers of 60 potato varieties, 185 seedlings and 45 *Solanum* species were surveyed, and a fungus-like structure was present in all tubers examined. The fungus mycelium was best observed in freehand sections stained with aceto-carmin. Hyphae were both inter- and intracellular. The fungus was present in potato tubers ranging in size from slightly enlarged rhizomes to large mature tubers. The fungus was most common in the cortex and vascular areas of the tuber. Attempts to isolate the fungus from tuber tissue failed.

A mycelium, similar to that occurring in tubers, was present in callus tissue cultures derived from the tubers, stems, rhizomes and leaf petioles of the potato plant. In tissue cultures the fungus was not as abundant and was more difficult to stain properly than in young tubers.

The mycorrhizal nature of the fungus was indicated by its relation to the tissue culture and the culture medium. The fungus in no case grew from the tissue culture onto the medium in the culture bottle. It also failed to grow on yeast extract agar and on Robbins' and Hervey's medium which are commonly used to reveal contaminants in tissue cultures.

No spores were observed in potato tubers or in culture materials.

Tissue cultures free of the fungus were established by dissecting small groups of cells from established cultures. In certain cases cultures free of the fungus were established by growing infected cultures on a medium containing antibiotics. There were no apparent differences, either in morphology or rates of growth, between the cultures where the fungus was present and those free of the fungus.

Evidence indicates that this organism may be seed borne within surface sterilized seed. (1) The fungus was present in tubers produced by plants grown from true seed under aseptic conditions, and (2) The fungus was present in tissue cultures derived from the stems of plants grown from true seed under aseptic conditions.

Because of the ever-presence of the fungus in tuber tissue grown under normal conditions, and because of the failure of attempts to separate the fungus from its host, it is possible that the fungus may have entered into a symbiotic, mycorrhiza-like association with the host tissue.

50 pages. \$2.00. Mic 57-1916

THE JACK PINE ASSOCIATION IN THE LOWER
PENINSULA OF MICHIGAN: ITS STRUCTURE
AND COMPOSITION

(Publication No. 21,380)

Dale Allen Zimmerman, Ph.D.
University of Michigan, 1956

The purpose of this study is to describe both structurally and floristically the jack pine plains of the Lower Peninsula of Michigan, to record the exact location of these "plains," and to point out heretofore unrecognized differences existing within that plant association in this region.

Field mapping and compilation of data from published maps shows that except for one more or less continuous large block of pine land in Oscoda, Crawford, and parts of adjacent counties, examples of this vegetation type, are widely distributed in northern Lower Michigan. These pine plains occupy only 475,000 acres (exclusive of plantings).

The largest and purest stands of jack pine are in the interior. Stands near the periphery of the association's range in Michigan (i.e., nearer to the Great Lakes) differ from interior stands structurally and floristically.

Data on stratification, coverage, constancy, and abundance were obtained through field studies in 150 quadrats in different forests, savannas, and "burns"--the three primary structural divisions of the jack pine association.

Four seasons of field work (resulting in the collection of 1,095 specimens), evaluation of published records, and examination of herbarium specimens have shown the pine plains flora to contain 176 species of vascular plants, 12 of which are introduced. Several species, previously reported in the literature, are not admitted to the list.

Examination of Michigan botanical history suggests that certain changes have taken place in the flora and vegetation of the area since the lumbering era in the 1890's.

Two to four strata occur in jack pine forests and savannas; usually only the arboreal and ground layers contribute appreciable coverage. The "intermediate" (low shrub)

layer and tall shrub layer are more often present, are better developed, and therefore provide more coverage in peripheral than in interior stands. Deciduous species are more frequent in the arboreal layer in peripheral stands. The number of species in the ground layer steadily decreases as coverage of the arboreal layer increases (in both peripheral and interior areas).

Some species are largely or completely restricted to peripheral stands; others to interior stands. Peripheral pine areas generally include deciduous forest species that are lacking in the interior pine plains.

Several general conclusions can be drawn from the study: (1) The flora of the interior jack pine plains is sparse because of severe environmental conditions which few plants can withstand: a dry, sandy, strongly acid substratum containing little organic matter, and deficient in lime and plant nutrients; frequent severe burning; a short growing season, with frequent killing frosts in early June and in early September. (2) Floristic differences between interior and peripheral jack pine stands probably are, in large part, the result of regional differences in length of growing season. The relatively long frost-free period in peripheral areas allows more species to thrive there than in the interior. (3) Apparent floristic and vegetational changes in the pine plains in recent decades probably resulted from deterioration of the soil (primarily the destruction of humus) through burning. (4) In Lower Michigan the jack pine plains represent a relict plant association which probably reached its peak of abundance in early post-Wisconsin time. It was replaced to a great extent by other pine communities until their removal through lumbering late in the nineteenth century, which resulted in a second period of abundance for jack pine in this region. More efficient fire control and prevention, modern silvicultural practices, and urban development will further limit expansion of the pine plains, but continued lumbering, small fires, and local abandonment of settled land will undoubtedly open up new areas for occupancy by the jack pine association in the future. 292 pages. \$3.75. Mic 57-1917

CHEMISTRY

CHEMISTRY, GENERAL

THE STEREOCHEMISTRY OF SOME RADICAL AND CARBENE ADDITIONS TO THE 2-BUTENES

(Publication No. 20,985)

Robert Cummings Woodworth, Ph.D.
The Pennsylvania State University, 1957

It was desired to discover something of the nature of the transient intermediates in the additions of free radicals and carbenes to the olefin double bond. The approach to this problem was based on the correlation of a reasonable reaction mechanism with the observed stereochemical course of a given reaction. The stereochemistry of the addition reactions studied was established by examination of the diastereomeric relationships of products derived from the *cis*- and *trans*-2-butenes. Infrared spectroscopy was the chief analytical method employed in establishing these relationships.

Experiments involving the radical addition of bromotrichloromethane to and the radical copolymerization of sulfur dioxide with the 2-butenes revealed that neither process is stereospecific, although the latter reaction had previously been reported to be stereospecific. The fact that these reactions are non-stereospecific rules out the possibility of a cyclic, three-membered intermediate radical, but fails to distinguish between the two remaining possibilities of a planar or a pyramidal intermediate radical. Calculations of non-bonding interactions for the ammonia molecule and for methyl and ethyl radicals indicate, however, that aliphatic free radicals, not conformationally constrained by ring systems, probably exist in the form of low pyramids which undergo rapid inversion.

It has recently been demonstrated that dibromocarbene adds stereospecifically to the 2-butenes, and this fact has been generalized in this study as a criterion for detecting other carbenes. Methylene from photolysis of diazomethane exhibited stereospecific addition to the 2-butenes, both in the formation of the expected 1,2-dimethylcyclopropanes and in the formation of the unexpected 2-pentenenes. Not only do these facts confirm the existence of carbene (methylene) as an intermediate species, but they also show that methylene exists in a singlet, rather than a triplet, state both in the gas phase and in solution.

The condensation of ethyl diazoacetate with various carbon-carbon double bonds by photolysis or copper-bronze catalysis has long been known and widely employed as a preparative method. The nature of the intermediate has not been known, however. Such condensations with the 2-butenes took place stereospecifically, establishing the existence of carbethoxycarbene as a reactive intermediate in these reactions. The *d*₁- acid and its ethyl ester, derived from *trans*-2-butene, and the two *meso*-acids and their ethyl esters, derived from *cis*-2-butene, have been purified and characterized.

By analogy with the behavior of sulfur dioxide, it was

thought that dichloro- and dibromocarbene might exhibit 1,4-addition to a conjugated diene. Experiments have shown, however, that only 1,2-addition to 1,3-butadiene occurs, yielding 1,1-dihalo-2-vinylcyclopropanes exclusively. The fact that only 1,2-addition is observed may be interpreted in support of the postulate that carbenes contain substantial carbonium ion character.

92 pages. \$2.00. Mic 57-1918

CHEMISTRY, BIOLOGICAL

A STUDY OF THE METABOLISM OF THEOBROMINE, THEOPHYLLINE, AND CAFFEINE

(Publication No. 21,165)

Herbert Harry Cornish, Ph.D.
University of Michigan, 1956

By a combination of column and paper chromatography, precipitation as silver salts, and ultraviolet spectrophotometry, the major metabolic products in man of theobromine, theophylline, and caffeine have been identified and quantitatively determined.

A serial quantitative precipitation of the silver salts of 7-methylxanthine and 3-methylxanthine in the presence of theobromine was possible by adjustment of the pH first to 1.0 (for 7-methylxanthine) and then to a pH of 5.5 (for 3-methylxanthine). Theobromine is not precipitated under these conditions.

Following the ingestion of 1 gm. of theobromine by each of two male subjects the excretion of 7-methylxanthine accounts for an average of 28 per cent, 3-methylxanthine 18 per cent, 7-methyluric acid 4 per cent, and unchanged theobromine 12 per cent of the 1 gm. dose. When 200 mg. of theobromine was given orally to a rabbit the dose was excreted as 7-methylxanthine (13 per cent), 3-methylxanthine (6 per cent), and unchanged theobromine (36 per cent). The feeding of 3- and 7-methylxanthine to the rabbit resulted only in the excretion of the unchanged compounds.

Approximately 75 per cent of a 1 gm. dose of theophylline is accounted for in man by the excretion of 35 per cent as 1,3-dimethyluric acid, 19 per cent as 1-methyluric acid, 13 per cent as 3-methylxanthine, and 10 per cent as unchanged theophylline.

The ingestion of 1 gm. of caffeine by man resulted in an average excretion of 27 per cent of the dose as 1-methyluric acid, 9 per cent as 1,3-dimethyluric acid, 19 per cent as 1-methylxanthine, 6 per cent as 7-methylxanthine, 5 per cent as 1,7-dimethylxanthine, and 1 per cent as unchanged caffeine.

The excretion of methylxanthines and methyluric acids in the urine account for 65 to 75 per cent of 1 gm. doses of theobromine, theophylline, and caffeine. In man,

theobromine and theophylline readily lose one methyl group and caffeine two methyl groups. The absence of any appreciable increase in true uric acid excretion suggests that demethylation does not proceed beyond the monomethylxanthines, otherwise xanthine and thus uric acid would be formed. 171 pages. \$2.25. Mic 57-1919

A STUDY OF BLOAT AND ACUTE INDIGESTION OF RUMINANTS: I. THE OCCURRENCE OF HISTAMINE AND TYRAMINE IN THE RUMEN OF SHEEP SUFFERING FROM ACUTE INDIGESTION. II. STUDIES ON STREPTOCOCCUS BOVIS, A PREDOMINATING STREPTOCOCCUS OF BLOAT AND OVERFEEDING SICKNESS

(Publication No. 21,078)

Joel Allan Dain, Ph.D.
Cornell University, 1957

I.

Histamine and tyramine have been identified and quantitatively determined as toxic constituents in the rumen ingesta of experimentally over-fed sheep.

The illness of the sheep was found to be directly correlated with the level of histamine in the ingesta. The sheep were moderately ill at histamine levels up to 5 μ g. per ml. rumen ingesta, very ill at 20 μ g. histamine per ml. rumen ingesta, whereas the rumen ingesta of the two sheep which had died, had a histamine content in the rumen ingesta of 70 μ g. per ml.

As the acidity of the ingesta became lower than about pH 5, histamine formation increased. Below pH 4.5 the levels of histamine reached values greater than 70 μ g. per ml. of rumen ingesta, and the animals became fatally ill.

The interference by heme in the determination of histamine in blood was eliminated by passing the butanol extract of blood over a sucrose column before subjecting it to the cotton acid succinate method.

II.

A requirement of CO₂ for slime formation on sucrose gelatin agar was demonstrated in the majority of strains of *S. bovis* tested. An occasional slime-producing strain showed distinct β -hemolysis on horse blood agar plates incubated under CO₂. In most cases there appears to be a correlation between slime formation on sucrose gelatin plates incubated in the presence of CO₂, inability to ferment mannitol, and greening on horse blood agar. The CO₂ requirement for slime production from sucrose gelatin plates can be replaced in the two strains tested by the inclusion of 0.1 percent tween-80 in the sucrose gelatin agar medium and incubating these plates anaerobically. The slime produced under the influence of CO₂ from one strain was purified and identified as a glucose-containing polysaccharide by paper chromatography of the hydrolyzate. 42 pages. \$2.00. Mic 57-1920

A STUDY OF PROTEOLYTIC FACTORS OF RUMEN MICROORGANISMS

(Publication No. 21,477)

Walter George Hunt, Ph.D.
The Ohio State University, 1957

For some time there has been great interest in the metabolism of ingested food in the rumen. Recently it has been shown that considerable hydrolysis of proteins takes place in this organ. Since there are no digestive juices secreted in the rumen by the host, it was concluded that the agent responsible for this hydrolysis was of microbial origin. This, proteolysis must be attributed to the microflora or microfauna of the rumen, either by the secretion of extracellular proteinases or by intracellular enzymes liberated into the rumen after death and autolysis of members of the microbial population.

Preliminary investigations showed that extracts of ground cells obtained by fractional centrifugation possessed considerable activity, while the supernatant fluid contained a relatively small amount. The proteinase found in the supernatant fluid was present in dilute quantities, and could not be concentrated without appreciable loss of activity. The proteinase obtained by extracting ground bacteria was considerably more stable. Incubation of one such extract at various pH values showed that the extract was active over a wide range, with the possibility of at least 5 different types of proteolytic systems. The enzymatic activity could easily be sedimented by centrifugation, indicating that the enzymatic protein was associated with an aqueous insoluble material. Treatment of the sediment with lysozyme, N-butyl alcohol, and sonic oscillations failed to liberate the active enzyme from the aqueous insoluble substance. Since attempts to isolate and purify this system from the heterogeneous rumen flora were not successful, efforts were then diverted to isolating a proteolytic rumen organism and cultivating it in pure culture form.

A medium which was modified to have a selective effect upon the rumen population, encouraging the growth of only those bacteria capable of utilizing protein, was used in isolating a gram negative, rod-shaped bacterium. The extracellular proteinase produced by this organism was purified some 500 fold by removing the non-enzymatic protein with calcium phosphate gel. Nevertheless, electrophoretic studies showed that the preparation consisted of at least 3 major electrically charged components. These components were separated on a starch column in minute quantities. Two were proteolytically active and the third inactive. Maximum activity was obtained at pH 7.5, rates of hydrolysis rapidly declining on either side of this value. The proteinase was irreversibly inactivated by reducing agents and sulphydryl group inhibitors, suggesting that a portion of the sulfide bonds must be in the oxidized state to preserve the molecular architecture of the enzyme for the proper substrate-enzyme complex formation, while another portion must be in the reduced state to serve as an active site of enzyme action. Enzymatic activity was enhanced almost twofold by the addition of 0.005 M CoCl₂. Evidence was presented to show that the proteinase acted as an endopeptidase; however, it was not able to hydrolyze any of the substrates considered specific for endopeptidases, nor was it able to hydrolyze a variety of peptides tested.

It was concluded that the most important role of this organism in ruminant nutrition is to bring about the initial attack on the protein molecule in order to provide substrates for other organisms which do not possess systems capable of hydrolyzing proteins.

96 pages. \$2.00. Mic 57-1921

DILATOMETRIC BEHAVIOR OF TRISTEARIN, TRIOLEIN, AND MIXTURES THEREOF

(Publication No. 21,249)

Vaidyanatha Mahadevan, Ph.D.
University of Minnesota, 1957

The thesis deals with the use of a dilatometer in studying some of the melting and solidification phenomena occurring in two simple triglycerides, tristearin and triolein, and binary systems composed of these two components.

Liquid tristearin solidifies in the dilatometer in different polymorphic modifications when cooled under different conditions.

Quick cooling of the melt below 0°C. produces the alpha form (Solid A) melting at 54.5°C. ("thrust-in" m.p.). Cooling of the melt at 54.5°C. for 20-22 minutes produces the beta-prime form (Solid E) melting at 64.0°C. ("thrust-in" m.p.). Heating both the alpha (Solid A) and the beta-prime (Solid E) forms to 71°C. and gradual cooling from 71°C. produces the beta form (Solid D) melting at 72.5°C. Two other solids (Solid B and Solid C) were obtained when tristearin melt solidified under gradual cooling conditions. Solid B was obtained when tristearin melt solidified at 64.0°C. on very gradual cooling. When Solid B was melted leaving a few seeding crystals and further cooled gradually, it solidified at 70°C. to give Solid C. The formation of these two solids under these conditions has been observed for the first time.

Solids A, D, and E are shown to be distinct polymorphic forms by their dilatometric behavior and x-ray diffraction patterns. Solids B and C, although different from A, D, and E in their dilatometric curves, were identical with Solid D in their crystal spacings and melting point. Their higher specific volumes have been shown to be due to the presence of pores or voids, since the confining liquid (mercury) could be forced into these pores by the application of pressure.

The melting points, and x-ray diffraction patterns of Solids A, D, and E agree well with those reported by Lutton for his alpha, beta, and beta-prime forms, respectively. Although the melting points of Solids A and E agree with the melting points of two of the four polymorphic forms reported by Malkin, they show differences in the x-ray diffraction pattern of Solid D agree well with those of the beta form of both Lutton and Malkin.

These different forms have now been characterized by their dilatometric curves.

The specific volume and hence, the melting dilation of triolein is found to vary within wide limits depending upon the tempering procedures.

Mixtures of tristearin and triolein of varying composition were suitably tempered so as to obtain their most stable modifications possessing maximum melting dilations, and their intersolubility measured from -30°C. to the "melting point" of tristearin.

An examination of the dilatometric curves of these mixtures reveals that the melting point of triolein is not raised or lowered and that the melting dilation of triolein is approximately proportional to the amount of triolein in the mixtures. Hence, it is reasonable to believe that probably no solid solution exists in the solid phase.

However, there is evidence for limited solubility of triolein in tristearin in those mixtures containing high proportions of tristearin in its unstable modifications.

The solubility of tristearin in liquid triolein at lower temperatures, i.e., from the melting point of triolein (5°C.) to 40°C. is found to be negligible, since the deviations of the actual slopes of the curves in this region were on both sides of the calculated values. Besides, the melting dilation of the tristearin phase appears discretely and in proportion to its amount as it melts.

It is shown that the "melting point" of tristearin in the mixtures is really a solution point, i.e., triolein dissolves small quantities of tristearin at temperatures much below the melting point of pure tristearin.

144 pages. \$2.00. Mic 57-1922

CRYSTALLIZATION AND DETERMINATION OF SOME PROPERTIES OF BOVINE LIVER ALDOLASE

(Publication No. 21,227)

Robert Joseph Peanasky, Ph.D.
The University of Wisconsin, 1957

Supervisor: Professor Henry A. Lardy

In liver tissue two hexose phosphate esters, fructose 1,6-diphosphate and fructose 1-phosphate, are metabolized by cleavage to trioses. The fractionation of liver was, therefore, undertaken to learn whether both hexose esters are cleaved by the same or by different enzymes.

The enzyme responsible for these activities was obtained from bovine liver in crystalline form. Purification was accomplished by: 1) extraction of ground beef liver in 0.15 M KCl at pH 7.6; 2) fractionation at -16° in the presence of 0.5 M KCl (initial concentration) between 48% and 61% (v/v) with methanol; 3) heat denaturation of inert proteins at 40° for 75 minutes in the presence of 0.3 M KCl (initial concentration) and 10% (v/v) methanol at pH 9.6; 4) adsorption of inert protein from the supernatant fraction of step 3 at pH 9.6 on aluminum hydroxide suspension; 5) adsorption of the enzyme at pH 9.6 on aluminum hydroxide suspension and elution with 0.4 saturated ammonium sulfate pH 7.4; 6) precipitation with ammonium sulfate between 0.4 and 0.7 saturation at pH 5.4. 7) Suspension of this precipitate in 0.4 saturated ammonium sulfate at 0° and pH 7.4 resulted in immediate crystallization. Recrystallization was accomplished at 0.39 saturation with ammonium sulfate pH 7.4 and 0° and gave rise to long needle shaped crystals. The preparation represents a 100 to 120 fold purification in 20% to 27% yield.

The preparation is free of fructose 1,6-diphosphatase, triose isomerase, glyceraldehyde phosphate dehydrogenase, α glycerol phosphate dehydrogenase, and adenosine 5'phosphate deaminase. It migrates as a single component in electrophoresis in 0.1 ionic strength acetate, cacodylate and phosphate buffers between pH 5.4 and pH 7.8. In 0.1 ionic strength phosphate buffers it was isoelectric between

pH 6.6 and pH 6.7. A molecular weight of 160,000 was calculated from s_{25}^0 , 8.49×10^{-13} sec., D_{25}^0 , 5.18×10^{-7} cm.²/sec., and a partial specific volume v_{25}^0 , 0.743 (all determined in 0.15 M KCl, 0.01 M phosphate buffer pH 6.7).

It exhibited a 280/260 ratio of 2.0 and $E_{1\text{cm}}^{1\%}$ (280 mu in phosphate buffer pH 7.4) of 8.4. It was shown to contain 30 sulfhydryl groups per mole.

The preparation attacks fructose 1,6-diphosphate at the rate of 400 moles of fructose 1,6-diphosphate cleaved per minute at 30° per 160,000 grams of protein. Fructose 1-phosphate is cleaved at 42% of this rate (conditions may not be optimal). Dihydroxyacetone phosphate and formaldehyde are condensed at a rate at least equivalent to that for fructose 1,6-diphosphate cleavage. In the presence of cyanide as a trapping agent the optimal pH for fructose 1,6-diphosphate cleavage was found between pH 9.2 and pH 9.4 and for fructose 1-phosphate cleavage between pH 8.2 and pH 8.4.

Preliminary studies on the effect of substrate on reaction velocity, optimal pH for fructose 1,6-diphosphate cleavage in the absence of trapping agent, and effect of electrolytes on the reaction velocity are reported.

The preparation of a beef liver protein of unknown function in the form of crystalline hexagons is reported.
139 pages. \$2.00. Mic 57-1923

A STUDY OF THE CALCIUM-BINDING PROPERTIES OF WHOLE CASEIN, α -CASEIN, AND β -CASEIN

(Publication No. 21,494)

Ralph Alfred Reisfeld, Ph.D.
The Ohio State University, 1957

Calcium interactions with the milk casein system are of interest in view of the generally adverse effect of calcium upon milk stability and the effect of ionic calcium on the physical state of the casein micelles.

In the study, equilibrium dialysis techniques were employed to investigate the calcium-binding properties of α -casein, β -casein, whole casein, and α_p -casein, i.e., α -casein devoid of κ -casein.

Equilibrium dialysis experiments at pH 6.0, 7.2, 8.4, 9.3, and 10.9 showed a decisive increase in the calcium binding of all casein components with increasing pH. No calcium binding was observed at pH 3.0. α -Casein exhibited the most pronounced increase in calcium binding with increasing alkalinity, β -casein and whole casein following in that order.

The increase in the numerical magnitude of the equilibrium constants of the calcium-binding process indicates an increase in the bond strength of the calcium-casein complex with a rise in pH.

A decrease in the total protein concentration caused more calcium binding sites to be available per unit weight of casein. This was thought to be due to the formation of smaller casein micelles as the result of dilution of the protein concentration, which opened up more active binding sites.

Increasing ionic strengths in the system produced a pronounced decrease in the calcium binding ability of

casein and its components, indicating that calcium-casein complexes are ionic in nature.

α_p -Casein was found to bind more calcium at pH 7.2 than ordinary α -casein. The observed irreversibility of this binding process was thought to be due to the presence of strong binding sites which are ordinarily protected by κ -casein in the α - κ -casein complex of ordinary α -casein.

The binding data as well as acid-base titration curves of casein and its components indicated the electrostatic nature of the calcium-casein binding process. Free carboxyl groups, zwitterion forms of imidazole and guanidinium groups, and phosphoric acid esters were considered to be the primary calcium binding sites of casein.

152 pages. \$2.00. Mic 57-1924

THE MUCOLIPIDS OF BRAIN

(Publication No. 21,124)

Abraham Rosenberg, Ph.D.
Columbia University, 1957

A water-soluble glycolipid was isolated from the gray matter of beef brain by extraction of the fresh tissue with chloroform-methanol at 0°, followed by dialysis of the extract against a large excess of water (a modification of the "partition-dialysis" procedure of Folch). The lipid appears in the resulting supernatant aqueous phase. The glycolipid of interest was separated from a number of highly acidic contaminants in the crude preparation by dissociation with CaCl_2 , followed by repeated partition between chloroform and water with the aid of methanol. The purified lipid behaved as a homogeneous ampholyte in the Tiselius apparatus ($u_{\text{pH}5.1}$ 8.96×10^{-5} cm.²/volt second, $u_{\text{pH}8.6}$ 10.6×10^{-5} cm.²/volt second). It sedimented with a single boundary in the ultracentrifuge. The sedimentation constant, s_{20}^0 , was 12.1×10^{-13} cm./second unit field; the diffusion coefficient, D_{20}^0 , was 6.3×10^{-7} cm.²/second; the apparent partial specific volume, \bar{v}_a , was 0.74 cc./gm. The calculated molecular weight was 183,000 gm./mole.

The lipid was degraded by various means and the following components identified: sphingosine, fatty acid (mainly lignoceric plus an unsaturated fraction), galactose, N-acetyl chondrosamine, "ovine" sialic acid, and a group of amino acids. The respective molar ratios of these identified components was 2:2:5:1:3:1; they comprised somewhat more than 90% of the total molecule. Based on physical properties and chemical components, the name mucolipid was assigned to the homogeneous glycolipid.

The mucolipid inhibited hemagglutination by a variety of viral types (influenza virus), showing a specificity differing from that of a urinary mucoprotein used as a reference.

The brain tissue of human, rat, rabbit, and mouse yielded a mucolipid possessing essentially the same components as those found in the beef brain preparation. A survey of rat organs indicated that a mucolipid was resident, not only in brain tissue, but also in spleen, and possibly, in heart. When a spectrum of rat brain cell fractions was prepared, the mucolipid was found concentrated in the heavier particulate matter (nuclei plus debris). However, added free mucolipid was also selectively adsorbed on this fraction.

An electrophoretically and ultracentrifugally homogeneous Tay-Sachs ganglioside preparation, isolated by a classical procedure, was found to differ from the mucolipid of normal beef brain in its inability to inhibit influenza virus hemagglutination, the relative ineffectiveness of sialidases in hydrolyzing the sialic acid moiety, its marked metachromatic effect, its lower sedimentation constant, and its lack of amino acids with the exception of a very small amount of serine.

140 pages. \$2.00. Mic 57-1925

STUDIES ON THE NUCLEOTIDE ARRANGEMENT IN DEOXYRIBONUCLEIC ACIDS

(Publication No. 21,126)

Herman Simon Shapiro, Ph.D.
Columbia University, 1957

A procedure is presented which is capable of uniquely characterizing and contrasting DNA specimens that cannot be otherwise distinguished. Moreover, it affords results which indicate that the sequence of nucleotides in the polymer is not based on a random arrangement of the nucleotides. The procedure is based on a standardized and quantitative method for the determination of the 3',5'-diphosphate esters of deoxycytidine(pCp) and thymidine(pTp) produced at three stages of acid degradation of DNA (deoxyribonucleic acid).

The types of nucleotide sequences that could serve as precursors of these pyrimidine nucleoside diphosphates (p-Py-p) were studied in experiments with several dinucleotides under dilute H_2SO_4 hydrolytic conditions at $100^\circ C$. These experiments together with kinetic studies on the rates of hydrolysis of the pyrimidine nucleosides and their phosphate esters indicate that the slow production of pCp or pTp from pyrimidine dinucleotides(CpCp, CpTp, and TpCp) follows the same pattern as the extremely rapid breakdown of purine-pyrimidine dinucleotides(ApCp) which give p-Py-p quantitatively; namely, an initial fission of one of the two glycosidic linkages, with the glycoside bond of the cytidine moiety more labile than that of thymidine. A secondary slower production of pCp and pTp can, therefore, be expected from pyrimidine dinucleotide precursors released during the acid degradation of DNA.

In extending the study of the production of pCp and pTp to DNA preparations and their fractions, obtained from different cellular sources, conditions were required permitting the approximate, but standardizable, differentiation between p-Py-p arising from trinucleotide sequences in which a pyrimidine is flanked by purines, and p-Py-p produced from pyrimidine oligonucleotides. The model experiments with dinucleotides led to the choice of three stages of hydrolysis for the differential analysis of the distribution density of pyrimidine nucleotides in the ten DNA preparations studied: I. 30 minutes; II. 60 minutes; III. 120 minutes; all in $0.1M H_2SO_4$ at $100^\circ C$. The rapid production of diphosphates during stage I essentially reflects the number of purine-pyrimidine-purine nucleotide sequences in the preparation. The subsequent slower production of diphosphates in the following stages is indicative of the type of pyrimidine oligonucleotide precursors predominating in the hydrolysate.

From the experimental results, the production of cytidine diphosphate at stage I ranges from 6.0% of the cytidylic acid content of a human spleen DNA preparation to 15.5% with a DNA from sea urchin sperm. The range of pTp is 12.8% of the thymidylic acid content of the same spleen DNA preparation to 23.5% with a calf thymus specimen.

The most obvious general feature is the non-identity of the analytical ratio of pyrimidines of the nucleic acid, T/C, and the ratio of produced diphosphates, pTp/pCp; contrary to what would have been expected from a polynucleotide structure based on a random sequential arrangement of mononucleotides. The results also permit the conclusion that the detailed aspects of the arrangement of pyrimidine nucleotides (and therefore purine nucleotides) vary widely in DNA specimens of different origin, providing a new means of their distinction, and that at least 70% of the DNA pyrimidines occur as oligonucleotide tracts containing three or more pyrimidine nucleotides in a row.

101 pages. \$2.00. Mic 57-1926

THE GLYCOGEN METABOLISM OF *TETRAHYMENA PYRIFORMIS*

(Publication No. 21,369)

Conrad Wagner, Ph.D.
University of Michigan, 1956

Protozoa in general and *Tetrahymena* in particular have been shown to contain large stores of an intracellular polysaccharide identical in many respects to glycogen obtained from animal sources. The present study has investigated more closely the role played by this glycogen in the metabolism of *Tetrahymena pyriformis*.

By means of ultracentrifugation it was found that the glycogen exists as subcellular granules of particle weight greater than fourteen million; the glycogen could be separated quantitatively by a centrifugal force of 100,000 times gravity. Using suspensions of resting cells it was found that the glycogen content of this organism doubled when incubated under aerobic endogenous conditions. This synthesis of glycogen took place only under aerobic conditions whereas fermentation of the glycogen was observed under anaerobic conditions. The endogenous synthesis was dependent on the age of the cultures as well as the initial cellular levels of glycogen and phospholipid. The phospholipid was a major fraction of the total lipids of the cells and an unusually high proportion of the fatty acids were present in the free form. Cellular integrity was found to be an essential condition for the endogenous synthesis of glycogen. Concurrent with the synthesis of glycogen, there were large decreases of cellular lipids and of protein nitrogen. The decrease in lipid was primarily in phospholipid while the lost protein nitrogen appeared as non-protein nitrogen, mainly ammonia nitrogen. The decrease of either lipid or protein alone was, in most cases, fully adequate to account for the observed synthesis of glycogen.

When the cells were incubated in the presence of added glucose, the aerobic synthesis of glycogen was stimulated several-fold. Furthermore the increase of glycogen synthesis above endogenous accounted for all of the added glucose. If butyrate, acetoacetate, or glycerol oleate was

added to suspensions of resting cells, glycogen synthesis was stimulated by 80 to 150 per cent. D,L-Phenylalanine, a ketogenic amino acid for mammals, stimulated glycogen synthesis significantly but L-glutamic acid, L-arginine, and D,L-threonine, which are glucogenic, as well as a mixture of the eleven essential amino acids, did not affect glycogen synthesis significantly. The amino acid mixture, however, did stimulate the ammonia production above the endogenous value whereas butyrate inhibited it to an equal extent.

These results have been taken to indicate that lipid serves as the source of the glycogen synthesized endogenous respiratory quotient showed a value of 0.65, a result which is compatible with such a conversion.

106 pages. \$2.00. Mic 57-1927

CHEMISTRY, INORGANIC

INFRARED STUDY OF SOME COMPLEXES OF THE PLATINUM METALS AND RELATED COMPOUNDS

(Publication No. 21,214)

Edward Grant Brame, Jr., Ph.D.
The University of Wisconsin, 1957

Supervisor: Professor Villiers W. Meloche

In recent years, infrared spectroscopy has been applied to the study of inorganic compounds and complexes. This has come about with the development of newer techniques in examining solid samples and with the development of increased instrument versatility. Of late, there has been a great interest in understanding the nature of the bonds that the central metal ions form with various coordinating ligands. These bonds give rise to absorption bands that generally occur in the wavelength region beyond 16 microns. Through a more complete interpretation of the bands that appear in this wavelength region, a better understanding of spatial arrangements of inorganic complexes would exist. At the present time little is known about the nature of metal-halogen vibrations. So, it was the object of this research program to (1) locate and establish the existence of metal-chlorine vibration bands and (2) to differentiate these bands from metal-nitrogen vibration bands.

Twenty eight metal-halogen salts were first examined in the infrared from 2 to 32 microns in wavelength to locate and establish the existence of metal-chlorine bands. Next, fourteen ammine and sixteen ethylenediamine complexes of various platinum metals were examined to confirm the existence of metal-chlorine vibration bands as well as to differentiate these bands from metal-nitrogen vibration bands. Finally, twelve ammine and ethylenediamine complexes of cobalt(III) and chromium(III) were examined to complete the interpretation of the results obtained from the study of the complexes of the platinum metals. All of the samples were examined in the solid state as KBr disks and the results from the KBr disk technique were checked with Nujol mull preparations. The 2

to 16 micron region of the infrared was scanned with the Baird Associates, double beam spectrophotometer while the 16 to 32 micron region was scanned with the Perkin-Elmer, single beam, double pass spectrometer.

The recorded spectra of some of the metal-halogen salts showed absorption bands in the 30 micron region of the infrared. These bands attributed to a metal-chlorine vibration were observed in the spectra of chloride salts of the platinum metals, rhenium(IV), and tungsten(III). The metal-chlorine vibration band was observed to shift in the direction expected from the mass effect by the substitution of different metal or halogen atoms. Also, the band was observed to shift its wavelength position with changes in the bond characteristic. This was exemplified by the change in band position from 31.3 microns to 29.2 microns for the spectra of platinum(II) chloride and platinum(IV) chloride, respectively. Changes in the metal-chlorine band intensity observed between a number of the compounds were correlated with changes in number of coordinating chlorine atoms as well as with changes in bond characteristic.

Bands were observed in the same spectral region of the infrared for the ammine complexes of the platinum metals where chlorine atoms were included in the coordination sphere of the metal ion as were observed for the chloride salts. Thus, these bands were also attributed to metal-chlorine vibrations. Shifts of bands and changes of band intensity were observed for the ammine complexes and they were correlated with the same causes as were noted for the chloride salts. Weak intensity bands were observed in the 20 micron region of the infrared for most of the ammine complexes. These bands were attributed to vibrations of the metal-nitrogen bond.

Absorption bands were also observed in the 30 micron region of the infrared for the ethylenediamine complexes of the platinum metals where chlorine atoms were included in the coordination sphere of the metal ion. These, too, were attributed to metal-chlorine vibrations. Here again, band shifts were noted. They were attributed to differences in charge or mass of the metal ion. Weak intensity bands were observed in the 20 micron region of the infrared for the ethylenediamine complexes as were noted for the ammine complexes. These were attributed to vibrations of the metal-nitrogen bond.

A band was observed around 30 microns for the ammine complexes of cobalt(III). It was observed in the same spectral position whether chlorine atoms were present or not in the complex. Also, it was observed to decrease significantly in intensity with the substitution of other ligand groups for the ammine group. Therefore, the band was assigned to a metal-nitrogen(ammine) vibration.

182 pages. \$2.40. Mic 57-1928

ANOMALOUS OPTICAL PROPERTIES OF
SOME METAL COMPLEX IONS

(Publication No. 21,248)

Vincent James Landis, Ph.D.
University of Minnesota, 1957

Adviser: Robert C. Brasted

This work describes an investigation of the Pfeiffer effect. The Pfeiffer effect is an anomalous optical rotation exhibited by certain solutions containing a metal coordination compound and a stable optically active compound. The optical rotation of a Pfeiffer effect system is not that of the optically active ion alone even though the coordination ion is racemic.

It was shown that the tris(ethylenediamine)zinc ion shows no Pfeiffer effect with d-bromcamphorsulfonate ion. Many ligands were added to solutions containing zinc ion together with d-bromcamphorsulfonate ion and shown to result in Pfeiffer-effect inactive solutions. The ligand 8-aminoquinoline was shown to form a Pfeiffer-effect active coordination complex with zinc ion and the resulting complex was identified to be bis(8-aminoquinoline)zinc. Aluminum and silver(I) ions were found to be unable to form complex ions showing the Pfeiffer effect in solution with the ligands tested. It was shown that the tris(1,10-phenanthroline)cobalt(II) ion and the tris(1,10-phenanthroline)cobalt(III) ion exhibit identical Pfeiffer effects with d-bromcamphorsulfonate. It was established that tris(1,10-phenanthroline)zinc d-bromcamphorsulfonate shows no Pfeiffer effect in methanol. Addition of ammonia to tris(1,10-phenanthroline)zinc d-bromcamphorsulfonate demonstrated that destruction of the asymmetric coordination complex results in loss of the Pfeiffer effect. Measurement of rotatory dispersions of tris(1,10-phenanthroline)zinc d-bromcamphorsulfonate and of ammonium d-bromcamphorsulfonate indicates that the anomalous rotation is not attributable to a single asymmetric center.

Polarographic investigations were executed as an aid in interpreting the results of the optical rotation studies. Polarography of the zinc and tris(ethylenediamine)zinc ions indicated the usefulness of the method in the detection of complex formation. A shift in the half-wave potential of zinc ion by 8-aminoquinoline showed evidence of complex ion formation by these two substances. A similar study of zinc ion and o-phenylenediamine demonstrated no evidence of complex formation between the zinc ion and the diamine.

Spectrographic studies of the Pfeiffer effect systems: zinc ion, 1,10-phenanthroline, and d-bromcamphorsulfonate; and zinc ion, 8-aminoquinoline, and d-bromcamphorsulfonate confirmed the conclusion that appreciable association is present in Pfeiffer-effect solutions even at very low orders of concentration.

Bis(8-aminoquinoline)zinc nitrate was prepared and characterized. This work is the first recorded preparation of that compound.

Pertinent characteristics of Pfeiffer-effect systems were discussed and the hypothesis of differential association was proposed as explaining the optical anomaly of these systems.

99 pages. \$2.00. Mic 57-1929

THE DEVELOPMENT AND EVALUATION
OF RADIOCHEMICAL SEPARATION
PROCEDURES FOR BARIUM, CALCIUM,
STRONTIUM, SILVER AND INDIUM

(Publication No. 21,363)

Duane Newman Sunderman, Ph.D.
University of Michigan, 1956

The objective of this research was to conduct a program of development and critical evaluation of radiochemical separation procedures. Procedures for individual elements reported in the literature are collected and subdivided into individual separation steps. Those steps which are found unique and possessing general applicability are studied experimentally to determine optimum conditions (of both yield and decontamination) for separation. These steps are then further evaluated under optimum conditions to determine the effects on the separation of a number of diverse but representative elements (Ag, Ba, Ca, Ce, Co, Cr, Cs, I, Ir, Ru, Sb, Se, Sn, Sr, Ta, Zr).

Barium, calcium and strontium were the first elements studied in this manner. Conditions for nitrate, chromate and chloride precipitations must vary widely from commonly accepted analytical methods due to the demands of such factors as nonequilibrium operation, necessity for rapid precipitation, character of the precipitate and manipulatory techniques. Yield data are given for barium, calcium and strontium in the above separations under conditions varied to show the effects of excess or deficiency of reagents, quantitative or nonquantitative precipitation and methods of adding precipitating reagents. Decontamination factors were determined with the representative tracers. Optimum procedures are given for the systematic separation of these three ions in tracer solutions.

The precipitation of the hydrous oxides of iron (III) and lanthanum (III) for scavenging purposes has been studied and their action and efficiency have been evaluated. Representative tracers have been used to determine the portion of each specie which would be carried either in the presence or absence of macro amounts of the contaminating activity. Higher decontamination may be accomplished by scavenging in the presence of carrier amounts of the contaminating species. Lanthanum precipitation is more specific with respect to the activities carried, while the more bulky iron hydroxide may give higher decontamination factors for certain elements.

The principle of isotopic exchange has been adapted to a novel separation and determination of radioactive silver in a mixture of radioactive species, and a quantitative procedure has been developed. The separation of radioactive silver by isotopic exchange with a silver chloride surface was found to be quantitative in fifteen minutes or less, even in the presence of high concentrations of many inorganic salts and organic solvents. The method is highly specific for silver with decontamination factors between 10^3 and 10^7 for eighteen representative radioactive species. The technique was also applied to the separation of silver from fission product mixtures and bombardment samples and found satisfactory in both cases.

The separation of radioactive silver by chloride precipitation and electrodeposition as well as by precipitation with benzotriazole from ammoniacal versene solution was evaluated. The precipitation reactions produce decontamination factors from 40 to 200 while the

electrodeposition of silver affords decontamination factors from 100 to 500 for many elements. A sample procedure is given which illustrates the capabilities of these methods.

The separation of indium by sulfide precipitation, by solvent extraction of the bromide with diethyl ether, and by anion exchange in hydrochloric acid solution has been evaluated. The sulfide precipitation lacks specificity as a decontamination step while the use of solvent extraction was found to give decontamination factors of 10^4 for dissimilar elements when conditions were well standardized. The technique of ion exchange loses much of its specificity when the flow rate is high as is required when time is an important factor. However, decontamination factors of about 10^3 were possible for many elements.

216 pages. \$2.80. Mic 57-1930

COORDINATION COMPOUNDS OF P,P,P',P'-TETRAETHYLETHYLENEDIPHOSPHINE

(Publication No. 20,899)

Charles Elmer Wymore, Ph.D.
University of Illinois, 1957

Complex compounds of ethylenediamine and other nitrogen bases capable of forming five-membered chelate rings are well known. The purpose of this investigation was to prepare a similar phosphorus compound, $\text{Et}_2\text{PCH}_2\text{CH}_2\text{PEt}_2$ and to study its coordination compounds.

Tetraethylethylenediphosphine (TEP) was prepared by utilizing the reaction of sodium salts of phosphines with organic halides in liquid ammonia. The work of Wagner and Burg (1) on the use of sodium amide and an organic halide in the preparation of trialkylphosphines from dialkylphosphines was extended to the preparation of the latter from monoalkylphosphines. Monosodium phosphide, prepared from the reaction of sodium with phosphine, was allowed to react with ethyl bromide to form monoethylphosphine. Without isolating the monoethylphosphine, diethylphosphine was prepared by addition of sodium amide and ethyl bromide to the reaction mixture. Diethylphosphine was then converted to tetraethylethylenediphosphine with sodium amide and ethylene dichloride.

Diamagnetic octahedral cobalt(III) compounds of the formula $[\text{Co}(\text{TEP})_2\text{X}_2]\text{X}$ ($\text{X} = \text{Cl}, \text{Br}$ or I) were prepared. The fact that they are ionic compounds is indicated by their conductance in nitrobenzene solution; the molar conductance of the chloro compound in water shows that two ions are present. An infrared analysis suggests that they have the *trans* configuration. The complex $[\text{Co}(\text{TEP})_2]\text{I}_2$ has one unpaired electron and is conducting in nitrobenzene solution, indicating a planar configuration, whereas $\text{Co}(\text{TEP})\text{Br}_2$ contains three unpaired electrons and is tetrahedral. These two cobalt(II) complexes are unusual in that in them the number of molecules of diphosphine coordinated to the cobalt appears to determine whether the complex acquires a planar or tetrahedral configuration. Infrared evidence for tetrahedral $[\text{Co}(\text{TEP})_2]\text{I}_2$ and $[\text{Co}(\text{TEP})_2]\text{I}_3$ was also obtained.

The complexes $\text{Ni}(\text{TEP})\text{X}_2$ ($\text{X} = \text{Cl}$ or Br) and $[\text{Ni}(\text{TEP})_2](\text{ClO}_4)_2$ were prepared, and found to be diamagnetic. They are, therefore, probably planar. Oxidation of $\text{Ni}(\text{TEP})\text{Br}_2$ with bromine gave a greenblack

compound of the composition $\text{Ni}(\text{TEP})\text{Br}_3$ which has oxidizing power. It has one unpaired electron, confirming the presence of nickel (III).

With the coinage metals, the compounds $[\text{Cu}(\text{TEP})_2][\text{Cu}(\text{TEP})\text{I}_2]$, $[\text{Ag}(\text{TEP})_2]\text{AgI}_2$ and $\text{IAuPEt}_2\text{CH}_2\text{CH}_2\text{PEt}_2\text{AUI}$ have been prepared. The first two give conducting solutions in nitrobenzene, supporting the structures written, and the gold(I) complex is non-conducting. Its molecular weight was confirmed ebullioscopically in chloroform. This white gold(I) complex was oxidized by iodine to a black gold(III) compound, the method of preparation and analysis of which suggest the formula $\text{I}_3\text{AuPEt}_2\text{CH}_2\text{CH}_2\text{PEt}_2\text{AuI}_3$.

Complexes of zinc, cadmium and mercury having the empirical formula $\text{M}(\text{TEP})\text{Br}_2$, as well as a complex of cadmium with the empirical formula $\text{Cd}_3(\text{TEP})_2\text{Br}_6$, were prepared. Other complexes of the diphosphine which were prepared were $\text{Pb}(\text{TEP})\text{Br}_2$, $[\text{Pb}(\text{TEP})_2](\text{ClO}_4)_2$ and $\text{Pd}(\text{TEP})\text{Cl}_2$. Attempts to prepare platinum and chromium complexes were unsuccessful, as were efforts to coordinate two diphosphine molecules to palladium. Some complexes containing triethylphosphine were also prepared for comparative purposes and their properties are described.

1. R. I. Wagner and A. B. Burg, J. Am. Chem. Soc. 75, 3869 (1953). 112 pages. \$2.00. Mic 57-1931

INVESTIGATION OF THE ANALYTICAL PROPERTIES OF SUBSTITUTED ANTHRANILIC ACIDS AND RELATED COMPOUNDS

(Publication No. 21,505)

William Allen Young, Ph.D.
The Ohio State University, 1957

Chelation reactions of the divalent cations of cobalt, nickel, copper, zinc, and cadmium were studied for the following organic acids: anthranilic acid, N-(methyl)-anthranilic acid, salicylic acid, 2,2' imino dibenzoic acid, 2,2' hydrazo dibenzoic acid, methylene dianthranilic acid, N,N' trimethylene dianthranilic acid, N-(aminoethyl)-anthranilic acid, 2-(aminoethyl)-benzoic acid, o-(carboxymethoxy)-benzoic acid, N-(carboxymethyl)-anthranilic acid, and anthranilic acid diacetic acid. The first three acids were purified commercial preparations; the remaining nine were synthesized. Details of these preparations are given, as well as infrared spectra, equivalent weights, and elementary analysis.

Acidity constants of the acids and formation constants for the chelation reactions were determined at 35°C. in 50 volume per cent dioxane-water as the solvent medium. Several methods were used for the evaluation of the acidity constants. The formation constants were determined by the Calvin-Bjerrum pH titration method. In most cases solutions having moles/liter concentrations of about 1×10^{-3} metal nitrate, 5×10^{-3} organic acid, and 5×10^{-3} nitric acid were titrated with 0.2 N. sodium hydroxide.

The favorability of the five-membered chelate ring containing nickel and the ethylene diamine structure previously observed for N,N'-ethylene dianthranilic acid has been observed in the present work with N-(aminoethyl)-anthranilic acid.

Comparison of the formation constants of anthranilic acid, N-(carboxymethyl)-anthranilic acid, and anthranilic acid, diacetic acid shows the progressive increases in chelate stabilities resulting from the addition of acetic acid groups to the amino group of anthranilic acid.

Among the compounds studied, only one of low experimental accuracy (salicylic acid) violates the generally observed Irving-Williams order of stability of the 1:1 complexes - $\text{Zn} < \text{Cu} > \text{Ni} > \text{Co}$.

In addition to the measurement of constants, colorimetric and precipitation reactions of these acids with metal ions were studied. Only anthranilic acid and methylene dianthranilic acid produce precipitates with the five cations in dilute aqueous solutions.

In general, the colors of the complexes of these acids with the five cations for which constants were measured are of weak intensity, and do not show promise as colorimetric methods of analysis. However, N-(aminoethyl)-anthranilic acid gives a yellow color with ferric ions. Study of this reaction indicates that iron can be determined fairly selectively at pH 3 in the range of 4 to 100 parts per million. 226 pages. \$2.95. Mic 57-1932

THE SYSTEM BARIUM-MAGNESIUM AND THE STRUCTURE OF BaMg_2

(Publication No. 18,046)

William Charles Zeek, Ph.D.
Syracuse University, 1956

The alloy system barium-magnesium has been investigated by thermal, photo-micrographic and x-ray diffraction methods with the following results.

1. The system has two congruent melting intermediate phases: BaMg_9 , M.P. 702.7°C and BaMg_2 , M.P. 613.0°C and one incongruent melting phase, Ba_2Mg_9 with a peritectic temperature of 602°C . There are three eutectics: BaMg_9 - Mg at 15.2% Ba, M.P. 620°C ; Ba_2Mg_9 - MgB_2 at 66.5% Ba, M.P. 591°C ; and BaMg_2 - Ba at 93.6% Ba, M.P. 362°C .

2. The identity of the incongruent phase as Mg_2Ba_9 instead of the possible compound MgBa_4 was established by x-ray diffraction methods.

3. The crystallographic data on the three intermediate phases found in the system are as follows:

BaMg_9 - hexagonal - space group D_6^h ($C_{6v}2$)

$a_0 = 10.65 \text{ A.U.}$ $c_0 = 10.40 \text{ A.U.}$

BaMg_9 - probably hexagonal

$a_0 = 10.69 \text{ A.U.}$ $c_0 = 16.01 \text{ A.U.}$

BaMg_2 - hexagonal - space group D_6^h (C_{6v}/mmc)

$a_0 = 6.663 \pm .005 \text{ A.U.}$ $c_0 = 10.557 \pm .005 \text{ A.U.}$

The structure of the intermediate phase MgB_2 has been investigated by single crystal x-ray diffraction methods with the following results.

1. MgB_2 crystallizes in the hexagonal system with the cell parameters

$a_0 = 6.663 \pm .005$ $c_0 = 10.557 \pm .005 \text{ A.U.}$

2. The density was found to be $3.065 \text{ gms, cm}^{-3}$ which requires a cell constant of 4 molecules (calc. 4.01) of MgB_2 .

3. Weissenberg photographs taken about the a_0 and c_0 axes showed systematically absent reflections for the ($hh\bar{2}l$) and (0001) when l was odd. No other restrictions were observed. The space group is D_6^h (C_{6v}/mmc).

4. The barium and magnesium atoms are distributed in the structure as follows:

Ba: $1/3, 2/3, u$; $2/3, 1/3, V_2 + u$; $2/3, 1/3, \bar{u}$; $1/3, 2/3, 1/2 - u$
where $u = -0.049$

Mg: 000; 001/2

$V, \bar{V}, 1/4$; $2\bar{V}, \bar{V}, 1/4$; $V, 2V, 1/4$; $\bar{V}, V, 3/4$;
 $2V, V, 3/4$; $\bar{V}, 2\bar{V}, 3/4$

where $V = 0.157$

5. The overall reliability of the structure as determined from a comparison of the observed and calculated structure amplitudes is 0.109.

96 pages. \$2.00. Mic 57-1933

AN INVESTIGATION OF THE CHEMISTRY OF THE CHLOROAQUOCHROMIUM(III) IONS IN ACID MEDIA

(Publication No. 21,378)

Bernard Zemel, Ph.D.
University of Michigan, 1956

The process of dissolution of an electrolyte in water is a complicated process leading to the formation of complex aquated ions. The purpose of this investigation is to consider in detail some of the ramifications of one such interaction, by considering the properties of the species formed in solution.

The present investigation is concerned with the behavior of the complex chromium(III) chlorides formed in solution. The experiments were performed in the presence of high concentrations of hydrogen ion so that the contributions due to basic species were negligible; the only ligands available for complexing chromium were chloride ions and solvent water.

The absorption spectra of the hexaquo, dichlorotetraquo, and chloropentaaquo-chromium(III) ions were observed in solutions of high perchloric acid concentration. It was found that the positions of the band maxima for these ions formed a sequence which shifted towards the red in a regular manner with an increase in the number of complexed chloride ions. In the presence of 12 M hydrochloric acid, the absorption spectra obtained fitted this pattern in a way consistent with the formulation of a new species in solution: trichlorotriaquo-chromium(III). The formation of the latter does not occur to any extent in concentrations of hydrochloric acid much below 12 M.

The polarographic behavior of the various chloroaquo-chromium(III) species indicated was observed in the

absence of maxima suppressors, and in the presence of various concentrations of perchloric acid and hydrochloric acid. The polarographic waves obtained for each of the chromium(III) species in the different media were analyzed; it was found that the results could best be explained by assuming two different concurrent mechanisms for the electron transfer process: the direct transfer of an electron to the chromium(III) ion at the mercury-solution interface, and the transfer of an electron to the chromium(III) ion from a chromium(II) produced at the mercury-solution interface. Only for the dichlorotetra-aquochromium(III) ion in the presence of 12 M hydrochloric acid does the direct transfer process appear to be dominant.

The reaction of the dichlorotetraaquochromium(III) ion with silver ion was studied in the presence of various concentrations of perchloric acid by the use of a titrimetric technique. The reaction was found to proceed in two well-defined steps: the conversion of the dichlorotetra-aquo ion to the chloropentaaquochromium(III) ion, and the subsequent conversion of the latter to the hexaquo species. The rates for the reaction were measured and found to be second order, proportional to both the silver ion and the chromium(III) concentrations. The rate constant for the first reaction at 25°C in 6.0 M perchloric acid, was calculated to be 120 ± 20 liters/mole/hour; that for the second reaction, 0.41 ± 0.01 liters/mole/hour. The rate of aquation of the dichlorotetraaquochromium(III) ion is about 10^5 times as rapid in the presence of silver as it is in its absence.

The kinetics of the reactions between the chloroaquochromium(III) ions and silver ion indicate a reaction mechanism which appears to involve the formation of a chloride bridge between the chromium and the silver ions; this is then followed by the loss of silver chloride and the addition of the water to the residual chromium species.

123 pages. \$2.00. Mic 57-1934

CHEMISTRY, ORGANIC

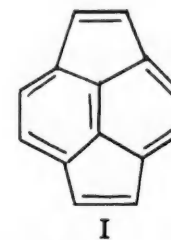
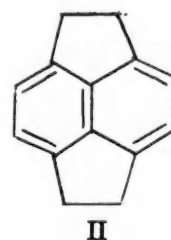
PART I: STUDIES RELATED TO THE SYNTHESIS OF PYRACYLENE

PART II: A PRELIMINARY INVESTIGATION OF SYNTHETIC ROUTES TO CYCLOPENTA[b]- AND CYCLOPENTA[c]THIAPYRAN

(Publication No. 21,194)

Robert Gordon Anderson, Ph.D.
University of Washington, 1957

Part I of this thesis describes several attempts to prepare pyracylene (I) along with two new methods for the preparation of acenaphthylene, an improved synthetic route to pyracene (II) and the synthesis of 1,2-dihydropyracylene.



The attempted methods for the conversion of pyracene to pyracylene were the same as those found to be successful in converting acenaphthene to acenaphthylene (benzylic bromination followed by debromination with zinc, acetate pyrolysis, and hydrogen transfer reactions). None of these methods gave pyracylene. However, the hydrogen transfer reaction with chloranil proved to be a convenient method for the preparation of 1,2-dihydropyracylene. The dihydro compound was found to be a reasonable stable molecule.

The first route to an improved synthesis of pyracene consisted of converting acenaphthene to 4,5-bis-(bromo-methyl)-acenaphthene followed by an attempt to cyclize the dibromide with phenyl lithium or zinc. This method gave no pyracene but seems to provide further evidence that the 5- and 6-positions of acenaphthene are farther apart than the 1- and 8-positions of naphthalene. The second approach involved the conversion of 1,4-dibromotetralin to 5-acenaphtheneacetic acid, which is one of the intermediates in the known synthesis of pyracene. This method was successful and is eight steps shorter than the known method.

Part II constitutes a preliminary investigation directed towards the synthesis of cyclopenta[b]- and cyclopenta[c]-thiapyran which are isoelectronic with the aromatic compound, azulene.

The approach to cyclopenta[b]thiapyran involved the preparation of cyclopentane-1-carboxy-2-acetic acid by a modification of the known method followed by reduction of this acid, or its ethyl ester, with lithium aluminum hydride. All preliminary attempts to convert the resulting diol, via the dibromide, to the saturated sulfur ring system were unsuccessful.

With a view towards preparing the cyclopenta[b]thiapyran ring system, the lactone of cyclopentanol-2-acetic acid and ethyl 2-bromocyclopentaneacetic acid were synthesized from cyclopentanone and an attempt was made to convert these compounds to ethyl 2-ketooctahydrocyclopenta[b]thiapyran-1-carboxylate. This new sulfide could not be realized by either treating the lactone with the disodio salt of thioglycolic acid or by allowing the bromide to react with the sodio salt of ethyl thioglycolate.

118 pages. \$2.00. Mic 57-1935

THE STRUCTURES OF LOW MOLECULAR
WEIGHT LIGNIN-LIKE SULFONATES

(Publication No. 21,195)

G. Merrill Andrus, Ph.D.
University of Washington, 1957

This research has been concerned with the structure of two crystalline substances, MA-1 and MA-2, which in prior research in this Laboratory were isolated from the mixtures of calcium lignin sulfonates resulting from the bisulfite delignification of wood. These substances were of particular interest because their molecular weights indicated that they may be monomeric members of the polymeric series of lignin sulfonates.

The compound, calcium 1-(3-methoxy-4-hydroxyphenyl)-2-propene-1-sulfonate has been synthesized and it has been established that it is identical with MA-1. Two additional compounds were formed as products of side reactions in this synthesis and they have been tentatively assigned the structures: calcium 3-(3-methoxy-4-hydroxyphenyl)-3-propanone-1-sulfonate and calcium 1-(3-methoxy-4-hydroxyphenyl)-3-hydroxypropane-1-sulfonate, the latter having been synthesized independently, though incompletely characterized.

Coniferyl benzoate has been sulfonated to give calcium 3-(3-methoxy-4-hydroxyphenyl)-2-propene-1-sulfonate in 21% yield and MA-2 in 34% yield. A structure tentatively assigned to MA-2 is calcium 3-(3-methoxy-4-hydroxyphenyl)-1-propene-2-sulfonate. An alternative structure also possible for MA-2 is calcium 3-(3-methoxy-4-hydroxyphenyl)-1-propene-1-sulfonate.

The relationship of MA-1 and MA-2 to lignin is discussed. The sulfonation of lignin model substances is reviewed in detail. 168 pages. \$2.20. Mic 57-1936

A STUDY OF MODEL COMPOUNDS
OF DPN AND DPNH

(Publication No. 21,196)

Gerald Berkelhammer, Ph.D.
University of Washington, 1957

An investigation of the scope of the "acid reaction" undergone by reduced diphosphopyridine nucleotide (DPNH) and model compounds of DPNH resulted in the finding that a carboxamido group in the 3-position of the dihydropyridine ring is not a necessary structural requisite for this reaction. Thus, three new model compounds which were prepared, namely, 1-benzyl-3-acetyl-1,4-dihydropyridine, methyl 1-benzyl-1,4-dihydronicotinate, and N-ethyl-1-benzyl-1,4-dihydronicotin-anilide, all were found to show the ultraviolet spectral changes in acid solution which define the acid reaction, that is, loss of the dihydro band near 360 m μ region. The kinetics of the acid reactions of these three compounds were followed, as well as of the previously known model compounds, 1-propyl- and 1-benzyl-1,4-dihydronicotinamide. Pseudo first-order kinetics were found in all cases. This, together with the relative rates of the compounds studied and spectral data, allowed the postulation of a partial mechanism involving protonation at the 5-position of the dihydropyridine ring, followed by reaction at the 6-position.

Attempts at preparing a crystalline acid product of a DPNH model compound succeeded only in the case of 1-benzyl-3-acetyl-1,4-dihydropyridine. Two such compounds absorbing in the 300 m μ region of the ultraviolet spectrum were, in fact, isolated from a solution of this dihydro compound in dilute hydrochloric acid. One of these was a water-addition product, as shown by elementary analysis. The kinetic and other data suggested this compound might be 1-benzyl-2-hydroxy-5-acetyl-1,2,3,4-tetrahydropyridine, and this was shown to be the case by an oxidation-hydrogenation sequence which led to the same product obtained by the hydrogenation of 1-benzyl-3-acetyl-6-pyridone. The second crystalline acid product contained the elements of the dihydro compound and those of water in a 2:1 ratio and has not been completely characterized.

The only materials absorbing near 300 m μ which were obtained from the acid treatment of 1-propyl- and 1-benzyl-1,4-dihydronicotinamide were resinous solids which could not be crystallized. In addition, these model compounds yielded crystalline products which displayed no ultraviolet absorption maxima and were shown by potentiometric titration to be dimeric in nature.

It was concluded that the data presently available on the acid reactions of DPNH and DPNH model compounds, on the one hand, and the enzyme-produced product, DPNH-X, on the other, were insufficient to allow any definite correlation between them.

Unsuccessful attempts were made to prepare double-bond isomers of DPNH model compounds by metal hydride reduction of several 1-alkyl-3-substituted-2- and 6-pyridones.

A study was made of the effect of certain basic species on model compounds of DPN (quaternary pyridinium halides with carbonyl-containing groups in the 3-position). Ultraviolet spectral changes were found to accompany basification of aqueous and alcoholic solutions of these compounds. These alterations were reversible with acid and were shown to be consistent with the formation of pseudo bases and pseudo base ethers at the 6-positions of the various rings. A dimolecular pseudo base ether derived from 3-acetylpyridine benzylochloride was isolated in quantitative yield on treatment of an aqueous solution of the salt with sodium hydroxide. This compound is believed to be the first of its kind to have been reported in the pyridine series. It was quantitatively reconverted to the quaternary salt with acid. A pseudo cyanide, 1-benzyl-3-acetyl-4-cyano-1,4-dihydropyridine, has been obtained in crystalline form from the action of cyanide ion on 3-acetylpyridine benzylochloride and has been shown to undergo an acid-catalyzed reaction which is accompanied by changes in the ultraviolet spectrum similar to those attending the acid reaction of DPNH and model compounds of DPNH. The action of dilute base on nicotinamide benzylochloride has been found to give rapid hydrolysis to nicotinic acidbenzylbetaine, as well as resinous products apparently resulting from ring attack.

122 pages. \$2.00. Mic 57-1937

EXPLORATORY SYNTHESSES IN THE
BENZOSUBERANONE AND
BENZAZEPINONE SERIES, WITH
EMPHASIS ON DIAZO OXIDES

(Publication No. 21,146)

William Lee Berry, Ph.D.
University of Michigan, 1956

An attempt has been made to apply a recently discovered reaction, which contracts a benzene ring to a cyclopentadiene ring by way of a diazo oxide, to some compounds in which the benzene ring is fused to a cycloheptene or azacycloheptene ring; this would constitute a new synthetic route to azulenes and azaazulenes. The required diazo oxides were prepared by diazotization of the corresponding amino phenols, which were synthesized by a variety of interlocking routes, designed both to find the most satisfactory path and to confirm the structures of the new compounds encountered.

The known benzosuberone was nitrated to give 3-nitrobenzosuberone-5, which was reduced and diazotized to give 3-hydroxybenzosuberone and 3-hydroxybenzosuberanol, each of which was converted to the 2,3-aminophenol by nitration and reduction. An alternative route was carried to the stage of 1-aminomethyl-7-methoxytetralin.

The ring-nitrogen analogs were prepared from 7-hydroxy-1-tetralone by ring-expansion with hydrogen azide, nitration, and reduction, giving 7-amino-8-hydroxy-4,5-dihydro-1-benzazepin-2-[3H]-one and thence the diazo oxide.

Model diazo oxides were also prepared by analogous routes; these compounds were acetophenone-, benzophenone-, acetanilide-, and diphenylmethane-3-diazo-4-oxide, and the known naphthalene-1-diazo-2-oxide. A number of other related compounds were synthesized, and some experimental refinements in the preparation of diazo oxides were developed. Degradation reactions and parallel syntheses were carried out where required for structure-proof.

The ring-contraction reaction, which is light-catalyzed with a quantum yield of one or less, was investigated with respect to practicality as a synthetic method, and found to be unsatisfactory with the low-intensity light sources (visible and near-ultraviolet) conveniently available in an organic chemical laboratory. The slow rate of reaction allowed coupling reactions between starting material and product to become dominant, and dye-like substances of apparently large molecular weight were formed.

The ring-contraction was found to be susceptible to catalysis by heat alone, and with naphthalene-1-diazo-2-oxide gave synthetically useful yields of phenyl indenecarboxylate and indenecarboxanilide, when carried out with phenol or aniline near their boiling points. When carried out with benzyl alcohol or benzylamine, reduction to β -naphthol occurred instead. The other diazo oxides, however, gave unidentified products of apparently deep-seated decomposition under all of these conditions. It is concluded that the diazo oxide ring-contraction is not a feasible route for the synthesis of azulenes and azaazulenes.

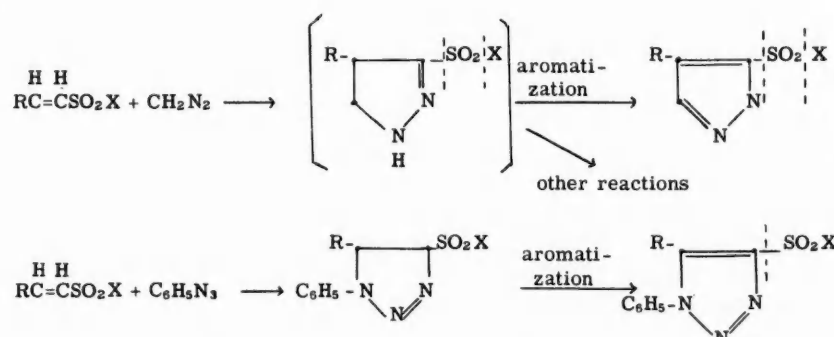
126 pages. \$2.00. Mic 57-1938

THE ADDITION OF DIAZOMETHANE
AND PHENYL AZIDE TO ALIPHATIC
 α,β -UNSATURATED SULFONIC
ACID DERIVATIVES

(Publication No. 21,161)

Pauline Wuai Kimm Chang, Ph.D.
University of Michigan, 1956

The ring-forming additions of diazomethane and phenyl azide to simple aliphatic α,β -unsaturated sulfonic acid derivatives were studied. Specifically, the effect of a β -alkyl substituent and the kind of sulfonyl derivative on the reactivity of the double bond, and the influence of the heterocyclic ring upon the chemistry of the sulfo group were investigated.



The α,β -unsaturated sulfonic acid derivatives studied in this work are ethylenesulfonyl chloride, propene-1-sulfonyl chloride, their corresponding N,N-diethyl amide and n-butyl ester, propene-2-sulfonyl chloride and α -bromoethylenesulfonyl chloride (the last with phenyl azide only). Their preparations involve mainly low-temperature dehydrochlorination of the corresponding 2-chloroalkane-sulfonyl chlorides with 2,6-lutidine or triethylamine.

Diazomethane reacts with α,β -unsaturated sulfonic acid derivatives to give the expected 3-sulfonylpyrazolines, the stabilities of which vary according to the sulfonyl group. The oily pyrazolines from diazomethane and the unsaturated sulfonamides and sulfonate esters (100% yield) were characterized by bromine aromatization to the corresponding pyrazoles. However, a pronounced tendency for concurrent cleavage by the hydrogen bromide liberated was observed. Pyrazoline-3-N,N-diethylsulfonamide gave 56% of pyrazole-3-N,N-diethylsulfonamide, 32% of 3-pyrazolidone hydrobromide and equivalent amounts of diethylamine hydrobromide and sulfate. 4-Methylpyrazole-3-N,N-diethylsulfonamide gave 59% of 4-methylpyrazole-3-N,N-diethylsulfonamide, a trace of 4-methyl-3-pyrazolidone and 18% of diethylamine hydrobromide and equivalent sulfate. A mechanism is proposed for the formation of the 3-pyrazolidone hydrobromides and diethylamine hydrobromide involving the cleavage at the sulfur-carbon bond prior to the aromatization, followed by decomposition of the unstable $\text{SO}_2\text{N}(\text{C}_2\text{H}_5)_2$ group to sulfur dioxide and diethylamine. The facile cleavage at the sulfur-carbon bond is ascribed to the nature of the pyrazoline ring. n-Butyl pyrazoline-3-sulfonate and n-butyl 4-methylpyrazoline-3-sulfonate undergo cleavage more readily at the ester link and give the corresponding 3-pyrazolesulfinic acids in 72% and 52% yield respectively. n-Butyl bromide, sulfate and a trace of pyrazole or 4-methylpyrazole were the other products. In contrast to the cleavage of the pyrazolinesulfonamides, the cleavage of the sulfur-oxygen bond predominates due to the nature of the ester link and the

unusual stability of the cleavage product, the 3-pyrazole-sulfonic acid zwitter ion. The pyrazoline from ethylenesulfonyl chloride decomposes spontaneously into 3-pyrazolidone hydrochloride, which was isolated when excess diazomethane was present. In the absence of excess diazomethane, the pyrazolidone adds to a second mole of ethylenesulfonyl chloride in the Michael fashion to give 2-(2-proto-3-keto-1-pyrazolidinyl)-ethanesulfonate. The propenesulfonyl chlorides reacted with diazomethane but did not give pure adducts.

Neither α,β -unsaturated sulfonic acid derivatives containing a β -methyl nor *n*-butyl ethylenesulfonate gave adducts with phenyl azide. *N,N*-Diethyl ethylenesulfonamide gave the corresponding triazoline (45%) which is stable and did not aromatize to the triazole when treated with bromine. α -Bromoethylenesulfonyl chloride also gave the expected triazoline which aromatizes spontaneously to 1-phenyl-4-bromo-1,2,3-triazole (45%) with expulsion of the chlorosulfonyl group. The triazolines from ethylenesulfonyl chloride and propene-2-sulfonyl chloride were not isolable as such owing to their extreme reactivity. They add to a second mole of the chloride in the Michael fashion to yield 2-(1-proto-1-phenyl-1,2,3-triazol-3-yl)-ethanesulfonate and 1-(1-proto-1-phenyl-4-methyl-1,2,3-triazol-3-yl)-propane-2-sulfonate in 100% and 45% yield respectively.

The reactivity of the conjugated double bond has been shown to be greatest in the chlorides, next in the esters, and the least in the amides. Diazomethane is more reactive than phenyl azide in the addition to the double bond. A β -methyl group exerts an inhibiting effect on the addition reactions; the effect is greatest in the amides, next in the esters and least in the chlorides, and it is more pronounced with the phenyl azide additions than with diazomethane additions. 142 pages. \$2.00. Mic 57-1939

PART I: AN IMPROVED SYNTHESIS AND SOME SUBSTITUTION REACTIONS OF AZULENE

PART II: STUDIES RELATED TO THE SYNTHESIS OF CYCLOPENTENO(c,d) AZULENE

(Publication No. 21,204)

Donald James Gale, Ph.D.
University of Washington, 1957

PART I

An investigation was made of the reaction sequence that was reported by Karl Ziegler for the preparation of azulene. It was found that the five-step sequence could be cut to three steps when a diethylene glycol solution of cyclopentadiene and sodium methoxide was treated with 1,5-bis-(*N*-methylanilino)pentamethinium chloride, forming [5-(*N*-methylanilino)pentadienylidene] cyclopentadiene, followed by dilution with diethylene glycol, heating to 205° and steam distillation of the product with super heated steam. A purification procedure for 1,5-bis-(*N*-methylanilino)pentamethinium chloride was found which would make the salt available in large amounts. Further investigation showed that treatment of pyridine with cyanogen bromide and *N*-methylaniline afforded 1,5-bis-(*N*-methylanilino)pentamethinium bromide in good yields.

In an effort to find a disubstituted azulene that could be used as an intermediate in the preparation of both known and unknown disubstituted azulenes, the 1,3-diacetoxymercuriazulene was investigated. The diacetoxymercuriazulene reacted with iodine to produce 1,3-diiodoazulene but treatment with bromine produced decomposition products. Treatment with acetyl chloride and ethyl chlorocarbonate succeeded in displacing only one of the acetoxymercuri groups while treatment with acetic anhydride and acetic acid afforded the 1-acetylazulene.

It was shown that azulene could be formylated with *N*-methylformanilide and phosphorus oxychloride and that the electrophilic substitution had taken place at the 1-position. The aldehyde was converted to its oxime and the oxime was dehydrated with acetic anhydride to the same azulonitrile as was obtained by treating azulene with cyanogen bromide and stannic chloride. The nitrile was converted to the known methyl 1-azulolate.

Treatment of azulene with sodium amide afforded a red aminoazulene which was characterized as its blue *N*-acetyl derivative. All attempts to convert this aminoazulene to a bromoazulene via the Sandmeyer reaction only led to polymeric materials, even under anhydrous conditions.

When azulene was treated with sodium and the resulting complex treated with carbon dioxide, the 1-azuloic acid was obtained. Dehydrogenation of the residue with chloranil afforded a small additional amount of the 1-azuloic acid. These results could be explained by a radical attack at the 1-position.

Treatment of azulene with chloroform and base afforded the same azulene-1-carboxaldehyde as was prepared previously. This result would indicate that a carbene could attack the 1-2-bond of azulene.

PART II

An effort was made to prepare the 4-azulylacetic acid which, it was felt, could be closed to a tricyclic ketone. Reduction of the ketone followed dehydration would then lead to the desired product. A number of Reformatsky reactions were run on 4-keto-decahydroazulene with both the methyl and ethyl bromoacetates and with *N,N*-diethyl- α -bromoacetamide. The 4-keto-decahydroazulene was also condensed with ethyl cyanoacetate.

Dehydrogenation of the unsaturated ethyl ester and the saturated methyl ester obtained from the Reformatsky reactions, followed by hydrogenation in the latter case, with palladium-on-carbon at 350° afforded only azulene and 4-methylazulene while dehydrogenation of the unsaturated methyl ester and the unsaturated ethyl cyanoacetate over the same catalyst afforded azulene, 4-methylazulene and a red solid which showed a carbonyl peak in the infrared spectrum. The "red ketone" appeared to be the desired tricyclic ketone but was obtained in very low yields and was quite unstable to heat.

Sulfur dehydrogenation of the unsaturated ethyl ester afforded a small amount of a blue acid which decarboxylated at about 50° to yield 4-methylazulene.

Other methods, such as nucleophilic substitution, were tried in an effort to obtain a 4-substituted azulene from which the 4-azulylacetic acid could be prepared, but they all failed. 214 pages. \$2.80. Mic 57-1940

THE EFFECT OF NEIGHBORING GROUPS ON
HYDROXAMIC ACID FORMATION BY
CARBOXYLIC ACID DERIVATIVES

(Publication No. 21,417)

Vivian Goldenberg, Ph.D.
Polytechnic Institute of Brooklyn, 1957

Various carboxylic acid derivatives react with hydroxylamine in alkaline solution to form hydroxamic acids which in turn react with iron to yield colored complexes. Despite the extensive use of this reaction in quantitative analysis, relatively little is known about the factors governing the rate of hydroxamic acid formation. The purpose of the present study was threefold: to investigate the influence of neighboring groups on the speed and course of hydroxamic acid formation, to obtain some explanation for the abnormal rates with which certain esters, amides, and imides react with hydroxylamine, and to learn why certain dicarboxylic acid derivatives apparently do not pass beyond the monohydroxamic acid stage. To this end, an extensive series of carboxylic acid derivatives was prepared. Hestrin's method for the colorimetric determination of esters was adapted for testing the reaction of these compounds with hydroxylamine. The test was carried out essentially as follows: To one volume of aqueous carboxylic acid derivative were added two volumes of aqueous alkaline hydroxylamine reagent. At periodic intervals, 1 ml. of hydrochloric acid solution, and 1 ml. of acidic iron reagent were added, in turn, to a 3 ml. aliquot of the reaction mixture. The resulting absorbances of the ferric-hydroxamate complexes were read with a Coleman spectrophotometer at 540 m μ .

The results of these tests may be summarized as follows:

- 1) The formation of hydroxamic acids from both monocarboxylic acid amides and esters is inhibited by bulky and electron donating groups. This suggests that the reaction proceeds via a nucleophilic displacement mechanism.
- 2) Monocarboxylic acid esters and amides react with hydroxylamine to yield one equivalent of hydroxamic acid. Dicarboxylic acid derivatives react with hydroxylamine to yield products containing either one or two -CONHOH functions. Compounds containing one or two carbon atoms between cis oriented carboxyl groups tend to form the monohydroxamic acids, in contrast to the more general reaction in which difunctional hydroxamic acids are produced. Those dicarboxylic amides which undergo monohydroxamic acid formation react with abnormally rapid speeds (for amides) with hydroxylamine. A mechanism which involves a cyclic transitional dihydroxamic acid intermediate and which is in agreement with the experimental evidence is suggested as an explanation for the scope and course of these reactions.
- 3) Succinamic acid, phthalamidic acid, and N-(o-carboxybenzoyl)-dl-phenylalanine react with hydroxylamine with much greater speeds than do the corresponding cyclic imides, which contradicts the theory that cyclic dicarboxylic imides are transformed into hydroxamic acids by a mechanism which involves a half hydrolyzed monoamidoacid intermediate.
- 4) The presence of -NH₂, -NHCOR, -OH, or -Cl in the alpha and beta positions of alkyl and phenalkyl monocarboxylic acid esters does not inhibit the rate at which hydroxamic acids are formed. However, in every case where these substituents are present in the alpha position, the subsequent color reaction between the resultant hydroxamic

acids formed and ferric iron in acid solution is depressed. The hypothetical existence of a six membered chelated structure is discussed in relationship to these phenomena.
114 pages. \$2.00. Mic 57-1941

THE PHOTOBROMINATION OF
2-PHENYLETHENE-1-SULFONYL CHLORIDE

(Publication No. 18,606)

Robert Loren Grimsley, Ph.D.
University of Michigan, 1955

This dissertation is primarily concerned with an investigation of the photobromination of 2-phenylethene-1-sulfonyl chloride. By way of introduction, examples from the literature of ionic and photochemical bromination of olefinic systems are presented and discussed. The photobromination of cinnamic acid is discussed at some length and several reported examples of "reversible" photobromination are described.

In carbon tetrachloride or acetic acid no reaction took place in the dark at room temperature between bromine and 2-phenylethene-1-sulfonyl chloride (S.S.C.). In acetic acid the initial rate of photobromination was governed by equation one.

$$-\frac{d(\text{S.S.C.})}{dt} = k_1 I^{1/2} (\text{S.S.C.}) \quad (1)$$

By contrast, unpublished work of C. D. VerNooy in this laboratory showed that the photo-reaction in carbon tetrachloride obeyed equation two.

$$-\frac{d(\text{Br}_2)}{dt} = k_2 (\text{Br}_2)^{3/2} \quad (2)$$

2-Phenylethene-1-sulfonyl chloride has an absorption maximum at 2737 Å ($\epsilon = 21,200$). The addition of bromine across the olefinic bond results in a seventeen-fold decrease in extinction coefficient and it has therefore been possible to determine the initial rate of reaction in acetic acid by dilution of successive samples with isooctane and measurement of their optical density at 2700 Å. A plot of optical density vs. time was extrapolated to zero time and the initial slope converted into concentration units.

The rate in acetic acid was dependent on the one-half power of the incident light except at high values where the rate increased more rapidly. Up to 31° the rate was only slightly dependent on the temperature but showed a greater dependence at 36°. A dark reaction was observed at 55° but not at 36°. Addition of lithium bromide to the reaction at 36° stopped the photobromination but did not catalyze an ionic reaction sufficiently to make it detectable.

In carbon tetrachloride with low light intensity, the product of the reaction was $\text{OCHBrCHBrSO}_2\text{Cl}$, while with high light intensity only OCHBrCHBrCl was produced. In acetic acid, five to ten per cent of a free sulfonic acid was obtained due to hydrolysis by the water present in the solvent. The remainder of the product consisted of approximately equal amounts of $\text{OCHBrCHBrSO}_2\text{Cl}$ and OCHBrCHBrCl ; no pronounced change in products occurred on changing light conditions.

The following mechanism has been advanced to explain the initial behavior of the reaction in acetic acid:

- (1) $\text{Br}_2 \longrightarrow 2\text{Br}\cdot$
- (2) $\text{A} + \text{Br}\cdot \longrightarrow \text{ABr}\cdot$
- (3) $\text{ABr}\cdot + \text{Br}_2 \longrightarrow \text{ABr}_2 + \text{Br}\cdot$
- (4) $2\text{Br}\cdot \longrightarrow \text{Br}_2$

Instead of proceeding smoothly to completion (as was the case in carbon tetrachloride), the reaction in acetic acid was very slow after about one-half of the starting material had reacted. The reason for this behavior is not clear but may be due to any one of a number of factors. The reaction may be reversible with an equilibrium being established when about 50% of the material has reacted. A wall reaction may play a prominent part in the initial stages of reaction. This is suggested by the observation that cleaning of the reaction vessel with Alconox followed by a water rinse and drying results in a slower rate than when the reaction vessel is cleaned with live steam. Deposit of reaction products on the vessel walls might result in an abnormal decrease in rate as the reaction progressed. A third possibility might be the formation of an inhibitor during the course of reaction which could serve as a chain breaker.

113 pages. \$2.00. Mic 57-1942

I: STEREOCHEMISTRY OF RADICAL ADDITION REACTIONS

II: SOLVOLYSIS AND ELIMINATION REACTIONS IN THE CYCLOPENTYL AND CYCLOHEXYL SYSTEMS

(Publication No. 21,221)

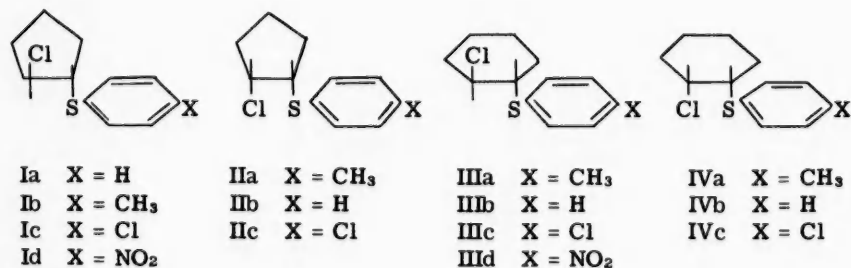
King Lau Howe, Ph.D.
The University of Wisconsin, 1957

Supervisor: Associate Professor Harlan L. Goering

The radical addition of hydrogen bromide to 1-methylcyclopentene under the influence of ultraviolet light was found to proceed predominantly in the *trans* manner to give a mixture of 1-bromo-2-methylcyclopentanes containing 94.3% of the *cis* isomer and 5.7% of the *trans* isomer.

The radical addition of thiophenol, *p*-chloro and *p*-methyl thiophenols, hydrogen sulfide, and benzyl mercaptan to 1-chlorocyclopentene likewise proceeded predominantly in the *trans* manner giving an adduct containing 78-88% of the *trans*-addition product. The stereospecificity of the radical addition of thiophenol and hydrogen sulfide does not appear to depend on the concentration of the addenda.

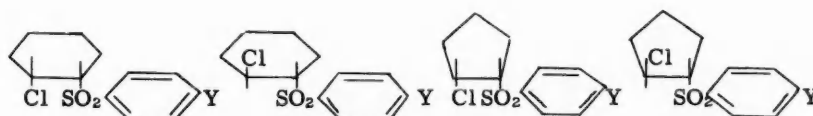
The rates of solvolyses of the following series of β -chlorosulfides in 80% ethanol were investigated:



In general, the *trans*- β -chlorosulfides were more reactive than the *cis*- β -chlorosulfides by factors of about 10^5 .

The relative solvolytic reactivity, $\frac{k_{\text{trans}}}{k_{\text{cis}}}$, are very similar for the cyclohexyl and cyclopentyl systems, being twice as large in the former system as it is in the latter. The solvolyses of the *trans* series (I) and (III) give excellent fits with the Hammett Equation. The ρ values for (I) and (III) at 20.05° are -1.453 and -1.495, respectively. Since the effects of neighboring sulfur participation in the ionization step are similar in the cyclohexyl and cyclopentyl ring systems, it was concluded that any additional strain involved in the participation of neighboring sulfur atom in the (presumably puckered) cyclopentyl system as compared to the cyclohexyl system must be indeed small. In the *cis* series, (II) and (IV), the rates of solvolyses are independent of the para substituent X, and the members of each series solvolyze at the same rate within experimental error.

The base-promoted dehydrochlorination of *cis*-(V), and *trans*-2-chlorocyclohexyl aryl sulfones (VI) and *cis*-(VII) and *trans*-2-chlorocyclopentyl aryl sulfones (VIII) in "80%" ethanol has been investigated.



Va Y = H	VIa Y = H	VIIa Y = H	VIIIa Y = H
Vb Y = CH ₃	VIb Y = CH ₃	VIIb Y = CH ₃	VIIIb Y = CH ₃
Vc Y = Cl	VIc Y = Cl	VIIc Y = Cl	VIIIc Y = Cl
	VId Y = NO ₂		VIIId Y = NO ₂

Rate constants and activation energies were determined for the least reactive of the four series of compounds, the *trans*-2-chlorocyclohexyl aryl sulfones (VI). The other three series of compounds are too reactive to follow by the sampling technique used in the present work. For these compounds approximate relative reactivities were determined. In each of the four series of chlorocycloalkyl aryl sulfones (V-VIII), electron withdrawing substituents in the aryl moiety increase the rate of dehydrochlorination. The following rate sequence for corresponding *p*-substituted 2-chlorocycloalkyl aryl sulfones was observed: *cis*-2-chlorocyclopentyl > *cis*-2-chlorocyclohexyl > *trans*-2-chlorocyclopentyl > *trans*-2-chlorocyclohexyl. The rate of elimination for *trans*-2-chlorocyclohexyl phenyl sulfone is essentially the same as that for *trans*-2-tosyloxycyclohexyl phenyl sulfone. The *trans*-2-chlorosulfones (VI and VIII) undergo *cis* elimination, evidently by a two-step process involving abstraction of the C₁ hydrogen followed by conversion of the resulting anion to the elimination product. The first step is rate determining and irreversible under the present conditions (i.e. 80% ethanol containing 0.004 to 0.03 M sodium hydroxide). Presumably the *cis*-chlorosulfones (V and VII) undergo a concerted *trans* dehydrohalogenation.

The stereochemistry of elimination of *cis*-(IX) and *trans*-2-methylcyclopentyl *p*-toluenesulfonate (X) was investigated. In pyridine, the elimination of (X) gave a mixture of alkenes consisting principally of 1-methylcyclopentene (XI) with a small amount of 3-methylcyclopentene

(XII). The reaction was interpreted in terms of a carbonium-ion mechanism. With sodium ethoxide in ethanol, the elimination of (IX) gave a mixture of alkenes containing 72.1% (XI) and 27.9% (XII), while the elimination of (X) gave a mixture of alkenes containing 14.4% (XI) and 85.6% (XII). The results were interpreted in terms of a trans bimolecular elimination reaction accompanied by some ionization of (IX) and (X) to the corresponding carbonium-ions followed by the loss of a proton. 124 pages. \$2.00. Mic 57-1943

**ATTEMPTED SYNTHESSES OF A POSSIBLE
DEGRADATION PRODUCT FROM THE DIMER
OF CYCLOOCTATETRAENE AND REACTIONS
OF RADICALS PRODUCED AT THE ANODE
DURING KOLBE ELECTROLYSES**

(Publication No. 21,419)

Peter Kabasakalian, Ph.D.
Polytechnic Institute of Brooklyn, 1957

Three attempts at the synthesis of a possible degradation product from the dimer of cyclooctatetraene which contains two double bonds were made so that it could be used as reference compound with which to compare the degradation product of the liquid cyclooctatetraene dimer. The three routes utilized 1,2,3,4-cyclobutanetetracarboxylic acid, succinosuccinic ester and methyl hydrogen Δ^4 -tetrahydrophthalate as their respective starting material. All three methods failed. The failure of the first procedure was due to the unavailability of the starting material through known chemical reactions, the failure of the second procedure was due to the inability of the initial reaction to proceed in the desired direction, and the failure of the third procedure was due to the inability to carry out the initial Kolbe electrolysis.

A study of the Kolbe electrolysis reaction was undertaken in order to determine the importance of the structural factors involved. The electrolysis of cis and trans methyl hydrogen hexahydrophthalate in anhydrous methanol was found to yield identical mixtures of uncoupled products, indicative of the formation of radicals which are free. Thus, the methyl ester of 1-cyclohexene-1-carboxylic acid, the ester of 2-cyclohexene-1-carboxylic acid and the methyl ester of cyclohexanecarboxylic acid were obtained as monomeric products. These products are formed as the result of the disproportionation of the secondary radicals formed at the anode. Coupled products were obtained for the first time from methyl hydrogen hexahydrophthalates, using Kolbe procedures. Saponification of the mixture of dimeric esters for experimental convenience gave two perhydrodiphenic acids, trans-anti-trans and trans-syn-trans, from both isomers mentioned above.

The electrolysis of cis-syn-cis, trans-anti-trans and trans-syn-trans perhydrodiphenic acids in anhydrous methanol yielded, as the principle product, a gamma lactone. The structure of the gamma lactone was established by chemical synthesis. Thus, the cis lactone of 2(-1-hydroxycyclohexyl)cyclohexanecarboxylic acid was obtained from the cis-syn-cis perhydrodiphenic acid and the trans lactone of 2(-1-hydroxycyclohexyl)cyclohexanecarboxylic acid was obtained from the trans-anti-trans and the trans-syn-trans perhydrodiphenic acids. The formation of the

gamma lactones may involve a hydrogen radical transfer reaction. No normal Kolbe products were identified in this reaction. 113 pages. \$2.00. Mic 57-1944

**COOL-FLAME COMBUSTION STUDIES
OF SOME HYDROCARBONS BY GAS
CHROMATOGRAPHY**

(Publication No. 21,442)

George Kyriacos, Ph.D.
The Ohio State University, 1956

The procedure by which hydrocarbons degrade during combustion to give carbon dioxide and water has been the subject of much speculation. The means that have been devised to accomplish this degradation are varied; however, they all suffer from an inadequate and undependable method of analysis. In this study a relatively new procedure in the field of analytical chemistry, gas chromatography, has been adapted for the analysis of the hydrocarbon combustion products in the cool-flame region. Gas chromatography has many advantages over the methods used in the past for gas analyses. It is extremely rapid and reproducible, and the apparatus is relatively simple to construct and operate.

Six hydrocarbons, n-pentane, n-hexane, 2-methylpentane, 3-methylpentane, 2,2-dimethylbutane, and n-heptane, were studied in the cool-flame region. Their cool flames were obtained and stabilized for analyses by changing the temperature in order to keep time constant. Samples were withdrawn from 20 cm. before cool flame, in the cool flame, 2 cm. post cool flame, and 40 cm. post cool flame for each of these hydrocarbons and analyzed by gas chromatography. Quantitative determinations for the following components of cool-flame oxidation were made: oxygen consumption, hydrogen, methane, and carbon monoxide on a "Molecular Sieve"-5A column; hydrocarbon consumption, saturated hydrocarbons, propylene, 1-butene 2-butene cis and trans, 1-pentene, 2-pentene cis and trans. Qualitative determinations were made for the higher olefins on a Dowtherm-A column; for ethane, carbon dioxide, ethylene, and water (by conversion to acetylene through calcium carbide) on a silica gel column.

Twenty-seven hydrocarbons were exposed to cool-flame oxidation under various conditions, and where possible their temperature profiles were plotted; from these some correlations were made. It was determined that hydrocarbons under 90 octane number gave temperature profiles, and that paraffins most readily gave cool flames, followed in order by cycloparaffins, olefins, and cyclo-olefins.

In conclusion it can be said generally that this work defined the applicability of the present cool-flame apparatus to the limitations of all types of hydrocarbons for cool-flame combustion. It definitely established the tremendous advantage and versatility of gas chromatography in cool-flame combustion analyses. From these analyses a mechanism was proposed to explain the process by which hydrocarbons oxidize. 133 pages. \$2.00. Mic 57-1945

I. ESTERIFICATION OF ACIDS WITH
O-METHYLCAPROLACTIM AND
DIMETHYL SULFATE
II. THE CHEMISTRY OF HAPLOPHYTINE

(Publication No. 20,870)

Ralph John Leary, Ph.D.
University of Illinois, 1957

Methyl esters can be prepared by the reaction of acids with O-methylcaprolactim. The reaction was carried out by dissolving the acid in O-methylcaprolactim and heating the resulting solution to 120° for twenty minutes. By this procedure, both benzoic and p-nitrobenzoic acids were converted to their methyl esters in better than 95 percent yields. Phenol and p-phenylphenol did not react with O-methylcaprolactim even upon heating for one and one-half hours at reflux temperature (160°). The reaction of p-nitrophenol and O-methylcaprolactim yielded p-nitroanisole. Therefore, it was concluded that O-methylcaprolactim will react only with compounds containing strongly acidic hydrogen atoms.

The reaction was run in a series of different solvents in order to determine whether it could be carried out at lower temperatures and in order to control the heating more closely and thereby eliminate discoloration due to overheating. The solvents employed were benzene, toluene, and xylene. In each instance the yield of the methyl ester was lower than that obtained by heating the mixture to 120°.

The esterification reaction was improved by employing a mixture of O-methylcaprolactim and dimethyl sulfate as the methylating agent. This modification of the reaction converted aliphatic and aromatic acids to their methyl esters in high yields. This method of esterification was particularly useful in making the methyl esters of o-disubstituted benzoic acids.

Highly activated phenols were converted to the corresponding anisoles by this procedure.

Amino acids and α -keto acids were not converted to their methyl esters by this method of esterification.

Ethyl esters were prepared by reacting acids with O-ethylcaprolactim and diethyl sulfate.

Haplophytine is an alkaloid isolated from the plant *H. cimidum* of the family Apocynaceae. It has the formula $C_{27}H_{31}O_5N_3$. Analytical data show the alkaloid contains two methoxy groups and one or two N-methyl groups.

The only stable degradation product obtained from a series of reactions was a compound $C_{16}H_{12}N_2O_2$, isolated from a zinc dust distillation. This neutral compound does not contain methoxy groups. The infrared spectrum indicated the presence of two carbonyl groups. The ultraviolet spectrum of the degradation product was similar to the spectra of β -carboline compounds. However, chemical evidence could not be obtained to prove the presence of a β -carboline nucleus. The ultraviolet spectrum of the degradation product was different from the ultraviolet spectrum of haplophytine. Therefore, it was assumed that the chromophoric group of haplophytine was either cleaved or rearranged in the zinc dust distillation.

The presence, in haplophytine, of an aminoketone ring that exhibits transannular interaction was indicated by comparison of the infrared spectra of haplophytine and haplophytine dihydrochloride. The presence of the aminoketone ring was further indicated by the electrometric titration of haplophytine dihydrochloride. The pK_a values

decreased in changing from 66 percent dimethylformamide to water, thus showing the proton was attached to an oxygen atom in the conjugate acid.

Haplophytine was shown to possess a 7-hydroxy-N-acyldihydroindole structural unit by comparison of its ultraviolet spectrum with that of an alkaloid which possesses this structural unit. The presence of the phenolic group was confirmed by the reaction of haplophytine with diazomethane. The methylated product no longer possessed acidic properties.

The five oxygen atoms in haplophytine can be assigned as follows: two methoxy groups, one phenolic group, and two carbonyl groups. Of the two carbonyl groups, one is present in an aminoketone ring and the other is present in the structural unit, 7-hydroxy-N-acyldihydroindole, either as part of a lactam ring or as part of an acyclic amide.

The carbonyl groups were unaffected by sodium borohydride reduction but completely reduced by lithium aluminum hydride.

98 pages. \$2.00. Mic 57-1946

STUDIES OF REPLACEMENT REACTIONS OF
THE MANNICH BASE, GRAMINE, AND THE
USE OF PRIMARY AROMATIC AMINES IN
THE MANNICH REACTION

(Publication No. 20,132)

James John Licari, Ph.D.
Princeton University, 1956

Part I: The 3-indole sulfur-containing derivatives of gramine.

The replacement of the dimethylamino group of gramine (3-dimethylaminomethyl indole) with some sulfur-containing nucleophilic reagents (mercaptans, sulfinic acids, sulfites) was studied. Reactions using gramine were thus extended to C-S type alkylations. These were found to proceed much more rapidly than the C-C alkylations already reported. In the course of this study, 3-indolemethane alkylsulfides were prepared in which the alkyl group was methyl, ethyl, n-propyl, n-butyl, n-amyl, and 3-indolemethyl. From gramine and sulfinic acids, the 3-indolemethane alkyl and arylsulfones were prepared for the first time. Derivatives were synthesized where the alkyl portion was methyl and ethyl, and where the aryl group was phenyl, p-tolyl, p-acetanilino, and -naphthyl.

Some N-exchange reactions of gramine with sulfonamides are also discussed in the first part.

Part II: Studies in the mechanism of the replacement of the dimethylamino group of gramine.

Several approaches to the mechanism proof are described. An attempt to follow the course of the reaction kinetically by following the mercaptan content by potentiometric silver nitrate titration was abandoned since both reactants and products interfered with the determination.

A stereochemical approach is proposed which involves the synthesis of a compound of the type α -R- α' -(3-indolyl)-dimethylaminomethane, resolution, and reaction of one of the optical antipodes with a nucleophilic reagent. A racemic product would suggest a mechanism proceeding via a carbonium ion, S_N1 mechanism, whereas an optically

active product would indicate an inversion, S_N2 type mechanism. The limitations of this approach and the possibilities for other mechanisms, such as of the addition-elimination type are discussed. The synthesis plan involved the preparation of a compound where R= methyl or ethyl, i.e., a 3-acylindole, oximation, reduction to the amine, and methylation. 3-Acetyl and 3-propionylindole were prepared from indolemagnesium iodide and acyl chloride. The C=O function in these compounds, however, did not behave as a true carbonyl function. Oximes and phenylhydrazones could not be prepared, or, if so, were prepared in small yield and under forced conditions. The abnormal chemical and infra-red spectral behavior of such ketones are explained in terms of resonance structures and C-O bond length.

Attempts to prepare the 3-acylindoles in a more direct way by the action of acyl chlorides on indole in ether resulted in the isolation of a number of new entities of a somewhat complex nature, involving two indolic portions and, in one product, the addition of the evolved HCl across a double bond of one indole moiety. Based on chemical and infra-red data, structures are proposed for these compounds.

Other synthetic approaches were also unsuccessful, e.g., an attempt was made to brominate 3-indoleacetic acid with N-bromosuccinimide. The compound obtained was N-bromo-3-indole acetic acid instead of the hoped for 3-indole- α -bromoacetic acid.

Part III: Some N-exchange reactions of gramine and extension of the Mannich Reaction to the use of primary aromatic amines.

The Mannich Reaction was extended to the use of primary aromatic amines in place of the usual secondary aliphatic amines, an aspect of the reaction that had been little explored up to the present work. The generality of the reaction was shown by the synthesis of numerous compounds involving indole, v-triazole, benzotriazole, 5,6-dimethylbenzotriazole, and antipyrine as the heterocycles bearing the active hydrogen, formaldehyde, and para- OCH_3 , O_2N , CO_2H , and SO_2NH_2 -substituted anilines. Para-substituted anilinomethyl heterocycles were obtained in almost all cases. In two cases the reaction was extended to the use of acetaldehyde in place of formaldehyde.

Two compounds, 3-(N^4 -sulfanilamidomethyl)-indole and 3-(p-carboxyanilinomethyl)-indole, were subjected to *in vitro* and *in vivo* antibacterial tests and were found to be only very slightly active.

A mechanism for this extended Mannich Reaction is proposed which involves the initial formation of an aniline Schiff base, followed by the rapid addition of the heterocyclic compound at the active hydrogen site. Competing reactions are proposed in the light of other products isolated.

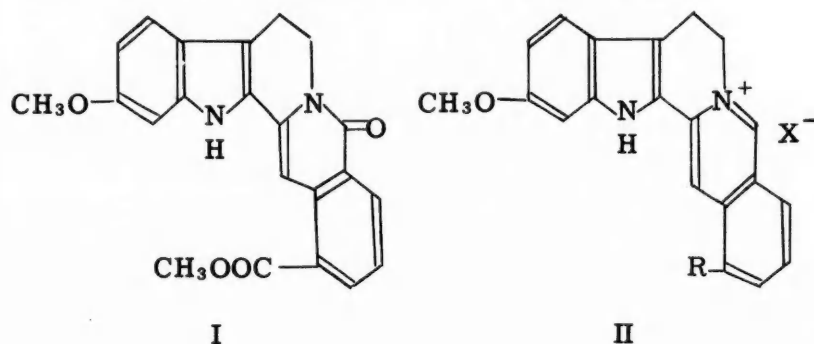
93 pages. \$2.00. Mic 57-1947

THE STRUCTURE OF ALSTONILINE OXIDE AND THE SYNTHESIS OF SEVERAL ANALOGS OF ALSTONILINE

(Publication No. 21,334)

Orville Lavern McCurdy, Ph.D.
University of Michigan, 1956

Alstoniline oxide, the product of air oxidation of either the alkaloid alstoniline or of tetrahydroalstoniline has been shown to possess the structure I, previously proposed by Elderfield and Wythe without experimental evidence.



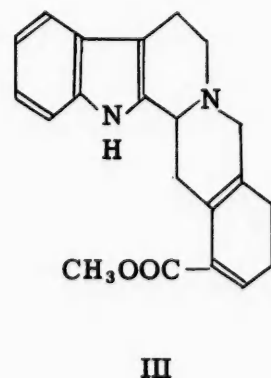
As such, it is neutral and contains no double bonds readily reduced by catalytically activated hydrogen in neutral solution. Its infrared spectrum shows the presence of an amide and an ester grouping. Its ultraviolet spectrum resembles that of ketoyobyrine. Alkaline degradation parallels that of ketoyobyrine and gives norharmane and 2-methylisophthalic acid. Reduction of alstoniline oxide with aluminum lithium hydride and reoxidation of the reduction product gave results consistent with this interpretation of the structure of the oxide.

Three approaches to the total synthesis of alstoniline (II, R = CH_3OOC) have been investigated.

(1) 11-Methoxy-7,8-dihydro-13H-benzo[g]indolo [2,3-a] quinolizium bromide (II, R = H) has been prepared by Fischer closure of the indole ring from the m-methoxyphenylhydrazone of 1-keto-7,8-benzo-1,2,3,4-tetrahydroquinolizium bromide. Three other analogs of II (R = H) have been prepared. This synthesis failed when applied to alstoniline. The behavior of II (R = H) on reduction and the dehydrogenation of the reduction product has been studied.

(2) Synthesis of tetrahydroalstonilinol by condensation of 5-carboxy-N-(β -bromoethyl)-1-isoquinolone with 3-sodio-3-acetyl-6-methoxyindole followed by hydrolysis of the acetyl group and reduction with aluminum lithium hydride was attempted. The initial condensation could not be accomplished.

(3) A successful synthesis of 1-carbomethoxy-5,7,8,



13,13b,14-hexahydrobenzo[g]indolo 2,3-a quinolizine (III) has been accomplished by condensation of 5-carbomethoxy-isoquinoline with 3-(β -bromoethyl)indole followed by reduction of the product with sodium borohydride. This route should be applicable to the synthesis of alstoniline itself. 88 pages. \$2.00. Mic 57-1948

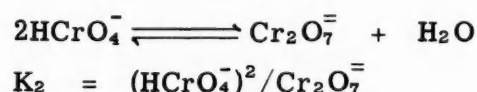
A KINETIC STUDY OF THE CHROMIC ACID OXIDATION OF BENZALDEHYDE

(Publication No. 21,208)

Theodore Mill, Ph.D.
University of Washington, 1957

A kinetic study of the chromic acid oxidation of benzaldehyde has been carried out in 91 per cent acetic acid-water solvent at 30°. The reaction is sensitive to the solvent composition to a high degree; the rate of reaction increases four hundred times in going from fifty per cent to ninety-five per cent acetic acid.

The rate law for the reaction has been established as first order in aldehyde and a function of the H_0 of the medium using perchloric acid. A spectral study of the chromium (VI) monomer-dimer equilibrium.



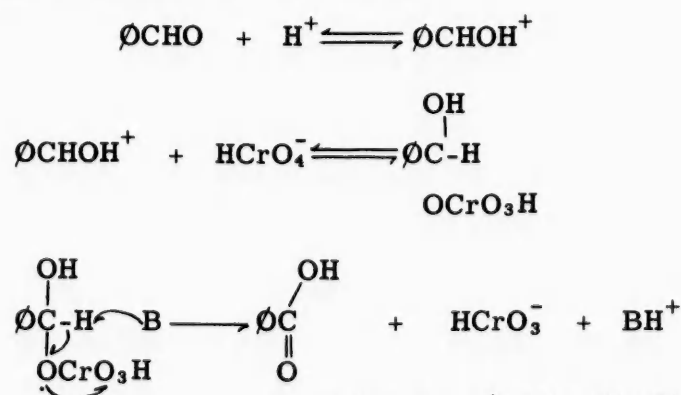
permitted an estimate of the value of K_2 of 0.040. The equilibrium constant was correlated with the kinetic data demonstrating that some monomeric chromium (VI) species is the principal oxidizing agent. A negative salt effect was observed, probably due in part to the above equilibrium.

The Arrhenius activation energy for the reaction is 12.9 1.1 kilocalories; the entropy of activation is -7.2 e.u. between 30° and 60°. Six meta- and para- substituted benzaldehydes were oxidized and the rates measured. Electron withdrawing groups enhance the rate of oxidation. A Hammett rho value of +1.02 was found.

Deuterobenzaldehyde was prepared and its rate of oxidation was measured. An isotope effect, k_H/k_D , of 4.03 + 0.24 was found.

Manganous ion was inductively oxidized during the course of the oxidation of the aldehyde. No manganese dioxide was formed and the induction factor could not be measured. Under certain conditions, added manganous ion reduced the rate of loss of oxidizing power to one-third of its normal value.

A mechanism, consistent with all of the observed facts has been proposed for the reaction.



130 pages. \$2.00. Mic 57-1949

REACTIONS OF THE PRODUCTS FORMED FROM DIAZOMETHANE AND ACYCLIC SUGAR DERIVATIVES

(Publication No. 21,488)

Jerry Blair Miller, Ph.D.
The Ohio State University, 1957

The known product obtained by the action of diazomethane on keto-D-fructose pentaacetate has been proved to be an epoxide by conversion to crystalline 1-chloro-1-deoxy-2-hydroxymethyl-D-glucitol [mannitol?] whose structure was determined by periodate oxidation. Addition of hydrogen chloride and hydrogen bromide to the epoxide ring has also given crystalline derivatives. Hydrogen bromide treatment of the epoxide has given crystalline 2-acetoxy-methyl-3,4,5,6-tetra-O-acetyl-1,2-dibromo-1,2-dideoxy-D-glucitol [mannitol?]. The halohydrins were converted to epoxides by treatment with bases.

The known product obtained by the action of diazomethane on keto-L-sorbose pentaacetate has been proved to be an epoxide by the addition of hydrogen chloride to the epoxide, the resulting product being a sirup, however.

Evidence was obtained that the epoxide derived from D-fructose and that derived from L-sorbose by treatment with diazomethane are C5 epimers.

These epoxides show absorption at 7.9, 11.1, and 11.6 μ .

Reduction of the known 1-deoxy-1-diazo-keto-D-gala-heptulose pentaacetate with aluminum amalgam has given the known 1-deoxy-keto acetate, and reduction with either hydrogen sulfide or sodium dithionite has given crystalline 3,4,5,6,7-penta-O-acetyl-D-gala-heptosone 1-hydrazone. This hydrazone forms a crystalline aldazine with β -hydroxynaphthaldehyde and on acetylation gives a crystalline product of unproven structure.

Reduction of the known 1-deoxy-1-diazo-keto-D-fructose tetraacetate by hydrogen sulfide has given 3,4,5,6-tetra-O-acetyl-D-glucosone 1-hydrazone.

In the conversion of the diazomethyl-keto acetates to the hydrazones, the 4.7 μ diazo absorption band disappears, but the 6.1 μ band is retained.

The Zemplen-Kiss nitrile to amide conversion has been reversed by the conversion of D-galactonamide pentaacetate to the corresponding known nitrile by the action of p-toluenesulfonyl chloride.

The crystalline p-toluidides of D-arabonic acid tetraacetate and D-galactonic acid pentaacetate have been synthesized.

The action of hydrazine on 2,3,4,6-tetra-O-methyl-D-glucose has given a crystalline product of unproven structure. 131 pages. \$2.00. Mic 57-1950

THE CONDENSATION OF GRIGNARD REAGENTS WITH 3-PYRIDYL AND 3-QUINOLYL KETONES

(Publication No. 20,877)

John Joseph Miller, Ph.D.
University of Illinois, 1957

The preparations of 3-mesitylpyridine and 3-duroylpyridine have been accomplished by means of the Friedel-Crafts reaction. Treatment of these ketones with

phenylmagnesium bromide gave rise to dihydro 1,4-addition products formulated as 1,2-dihydro-4-phenyl-3-mesitoylpyridine and 1,2-dihydro-4-phenyl-3-duroylpyridine. The reaction of the phenyl reagent with 3-benzoylpyridine gave diphenyl-3-pyridylcarbinol in 22% yield and 1,2-dihydro-4-phenyl-3-benzoylpyridine in 45% yield.

Dehydrogenation of the dihydro compounds with chloranil yielded 4-phenyl-3-benzoyl-, 4-phenyl-3-mesitoyl- and 4-phenyl-3-duroylpyridine.

Treatment of 3-benzoylpyridine with benzylmagnesium chloride and hydrolysis with ammonium chloride and hydrochloric acid gave benzylphenyl-3-pyridylcarbinol hydrochloride, which was dehydrohalogenated with base. 1,2-Dihydro-4-benzyl-3-mesitoylpyridine, which was obtained from 3-mesitoylpyridine and the benzyl reagent, has not been successfully dehydrogenated.

Reactions with the methyl reagent have been less fruitful. High melting materials, which might be coupling products, have been isolated from the reactions of 3-mesitoylpyridine and 3-duroylpyridine with methylmagnesium iodide.

3-Benzoylquinoline and 3-mesitoylquinoline were synthesized from 3-quinolinecarboxylic acid. The phenyl reagent reacts with these ketones to give 1,2-dihydro-4-phenyl-3-benzoylquinoline and 1,2-dihydro-4-phenyl-3-mesitoylquinoline, respectively. Chloranil effects the aromatization of these dihydro compounds smoothly. The benzyl reagent combines with the 3-quinolyl ketones in the 1,4-manner.

The action of polyphosphoric acid on 4-phenyl-3-mesitoylpyridine or 4-phenyl-3-duroylpyridine provides 2-azafluorenone. 3,4-Benzo-2-azafluorenone is obtained by similar treatment of 4-phenyl-3-mesitoylquinoline.

Unsuccessful attempts to assign the double bonds in the dihydro compounds, by reactions of the dihydro compounds with maleic anhydride and with hydroxylamine, were made.

An attempt to extend the Grignard reactions of 3-pyridyl ketones to acetomesitylene enolates failed.

It has been shown that 1,4-addition to an unhindered carbonyl group can be made to occur by choosing a compound which has a center, conjugated with the carbonyl group, which is active to nucleophilic attack.

93 pages. \$2.00. Mic 57-1951

MOLECULAR REARRANGEMENTS IN THE STEROLS: THE NON-REDUCTIVE SCISSION OF RINGS E AND F OF THE STEROIDAL SAPOGENINS

(Publication No. 20,141)

Robert Scott Miner, Jr., Ph.D.
Princeton University, 1956

Treatment of diosgenin acetate (I) in acetic anhydride solution with anhydrous hydrogen chloride and a subsequent reflux period results in the opening of both rings, E and F, of the spiro-ketal side chain. The resulting compound, (II) is 16-chloro-3,27-dihydroxy-5-cholesten-22-one diacetate.

The reaction of II with silver acetate in glacial acetic acid produces 3,16,27-trihydroxy-5-cholesten-22-one triacetate, (III). Mild saponification of III with potassium

carbonate in methanol liberates the 3,16,27-trihydroxy-5-cholesten-22-one, (IV), previously prepared by catalytic hydrogenation of kryptogenin, (V). Identity is further substantiated by dilute acid catalyzed recyclization of IV to diosgenin, (VI).

Extended reflux of II with potassium hydroxide in methanol results in the formation of a mixture of halogen-free compounds, (VII & VIII), of undetermined structure. Reaction of this mixture with dilute acetic acid again results in the recyclization of the side chain to form diosgenin in essentially quantitative yield.

It is reasoned that configuration is inverted at carbon atom #16 in the replacement of chlorine by acetate in the presence of silver ion. Potassium carbonate saponification is accomplished with retention of configuration. Inversion in the silver acetate reaction is typical of a sterically biased S_N1 mechanism wherein complete racemization of the intermediate carbonium ion is prevented by steric hindrance, here specifically the angular methyl group attached at carbon atom #13 and the side chain attachment at carbon atom #17, both of which are beta (forward). Since the fusion of rings D and E is cis beta (forward) it is concluded that IV bears a beta oriented hydroxyl group at carbon atom #16 which readily participates in acid catalyzed recyclization without Walden inversion. Thus it follows that the acetate group attached at carbon atom #16 in III is beta oriented and that the chlorine atom in II is alpha (backward) oriented.

Presumptive generality for the reaction producing II from diosgenin acetate is indicated by the infra red spectrum of the product from similar treatment of smilagenin acetate, (IX). The crystalline analog of II was not isolated.

Infra red studies on IV have shown conclusively that it exists essentially as a hemiketal, no carbonyl absorption being discernable. Mild carbonate saponification of II gave rise to the compound, XII, 16-chloro-3,27-dihydroxy-5-cholesten-22-one, which also exists as a hemiketal. Mild reacylation of XII produces XIII, 16-chloro-3,27-dihydroxy-5-cholesten-22-one 3-acetate, another hemiketal structure. Both XII and XIII, derived as they are from II, are postulated to have the chlorine atom at carbon atom #16 in alpha (backward) orientation. On the basis of these two compounds which have formed hemiketals with the hydroxyl group at carbon atom #27 and also on the basis of the inherent greater stability of pyranoid rings as compared with furanoid rings in the carbohydrates, it may be concluded that IV also exists as a hemiketal formed between the original carbonyl group at carbon atom #22 and the 27-hydroxyl group. The anomalous failure of kryptogenin, V, to form a hemiketal has been observed and a possible explanation proposed. Reflux of XIII with acetic anhydride results in reopening of the F ring with formation of II.

A mechanism is proposed for the non-reductive cleavage of rings E and F of the steroidal sapogenins. Mechanisms are also proposed for the complex metal hydride reduction of ring F and for the conversion of genins to pseudo genins both with and without the addition of Lewis acid catalysts.

101 pages. \$2.00. Mic 57-1952

POLYALKYLENE SULFIDE AND DISULFIDE POLYMERS

(Publication No. 20,881)

Leonard Elmer Olson, Ph.D.
University of Illinois, 1957

Introduction

Polymers containing the sulfide link are of interest because these polymers exhibit some rubber-like properties if branching or irregularities occur in the polymer chain (1). Sulfide polymers can successfully be prepared only from dimercaptans and unconjugated diolefins. Two commercially available non-conjugated branched diolefins are 4-vinylcyclohexene-1 and *d*-limonene. Since dimercaptans can be prepared from diolefins it was of interest to study the reaction between these diolefins and the dimercaptans prepared from these diolefins.

It has been shown that a disulfide linkage may be formed during the emulsion polymerization of sulfide polymers (2). Since the disulfide link is related to the sulfur linkage found in "Thiokol" rubbers it was of interest to prepare disulfide polymers from dimercaptans. The major portion of the present investigation describes the preparation of sulfide and disulfide polymers derived from 4-vinylcyclohexene-1 and *d*-limonene.

Discussion of Results

The peroxide catalyzed addition of thiolacetic acid to the double bonds of 4-vinylcyclohexene-1 and *d*-limonene and the hydrolysis of the resulting thioesters appeared to be the most promising way to obtain mercaptans from these diolefins. Thiolacetic acid reacts very vigorously with these diolefins if they have been allowed to stand several weeks since distillation. Two monothioacetates from 4-vinylcyclohexene-1 and dithioacetates from 4-vinylcyclohexene-1 and *d*-limonene were prepared. The thioacetates were hydrolyzed to give the corresponding mercaptans.

Polyalkylene sulfide polymers were prepared from β -mercaptoethyl-3(or 4)-mercaptocyclohexane and 4-vinylcyclohexene-1 and from α -methyl- β -mercaptoethyl-3-mercapto-4-methylcyclohexane (from *d*-limonene) with *d*-limonene. These polymers were sticky solids having an inherent viscosity of slightly over 0.4 in chloroform. With an inherent viscosity below 0.3 the polymers were sticky oils. Polymerization of unsaturated mercaptans produced only low molecular weight oils.

It was noted that the sulfide polymers precipitated from emulsion and many emulsifying agents were tried to find an emulsifier that would hold the polymer in suspension. The best emulsifying agents were MP-635-S (du Pont) and "Joy" (Procter and Gamble) although these agents were not successful in holding the polymer in suspension. No polymer was obtained when emulsifying agents derived from ethylene oxide were used.

The oxidation of dimercaptans to polydisulfides in emulsion or solution by the usual reagents for converting mercaptans to disulfides in the laboratory, produces acids or salts as by-products which act as coagulating agents for the polymer produced. Many references in the literature describe the oxidation of mercaptans with air or oxygen in a basic environment.

Dimercaptans were oxidized to form disulfide polymers

by passing air through a basic potassium laurate or myristate emulsion of the mercaptan, using a silicone oil, Antifoam A (Dow Corning) to control foaming. Since the oxidation proceeds slowly several substances were tried as catalysts but only selenous acid was found to speed up the oxidation under the conditions used (3). Disulfide polymers coagulated with alum coagulant contained salts which could not be removed by repeated reprecipitations so methanol was used to coagulate analytical samples. Wax-like disulfide polymers were prepared from hexamethylenedithiol, heptamethylenedithiol, nonamethylenedithiol and decamethylenedithiol. Rubber-like disulfide polymers were prepared from β -mercaptoethyl-3(or 4)-mercaptocyclohexane and α -methyl- β -mercaptoethyl-3-mercapto-4-methylcyclohexane (from *d*-limonene).

A thin film of a disulfide polymer from β -mercaptoethyl-3(or 4)-mercaptocyclohexane became progressively insoluble in solvents when exposed to an ultraviolet light.

A disulfide polymer when heated with sulfur incorporated 0.7 sulfur atom per disulfide link and became more "rubbery" and less soluble in solvents.

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SUBSTITUTED ARYL BORONIC ACIDS

(Publication No. 20,886)

Albert John Reedy, Ph.D.
University of Illinois, 1957

o- and *p*-Bromomethylbenzeneboronic acids were obtained by bromination of *o*- and *p*-methylbenzeneboronic acids under anhydrous conditions.

p-Formylbenzeneboronic acid was prepared from *p*-bromomethylbenzeneboronic acid in the Sommelet aldehyde synthesis. *o*-Formylbenzeneboronic acid was prepared by alkaline hydrolysis of *o*-dibromomethylbenzeneboronic acid.

p-Formylbenzeneboronic acid reacted with nitromethane and with acetone to form *p*-(β -nitrovinyl)-benzeneboronic acid and *p*-(β -acetovinyl)-benzeneboronic acid, respectively, in good yields. The cyanohydrin and the azine of *p*-formylbenzeneboronic acid were obtained in good yields. Oxidation and reduction of the formyl group in *p*-formylbenzeneboronic acid were accomplished without difficulty, and the acid and alcohol were obtained in good yield. *p*-Formylbenzeneboronic acid condensed with dimethylaniline at 100° with the aid of hydrochloric acid as a catalyst. The condensation was accompanied by cleavage of the boronic acid function.

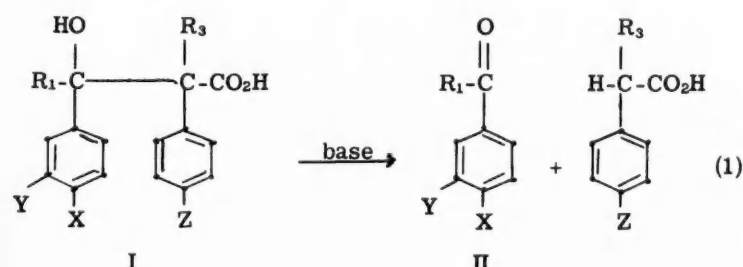
p-Formylbenzeneboronic acid was treated with malonic ester under Knoevenagel conditions. No boronic acid was obtained from this reaction. The reaction temperature of 130° apparently brought about a cleavage of the boronic acid function. *p*-Formylbenzeneboronic acid condensed with resorcinol to form a water soluble substance when an

THE BASE-CATALYZED DEALDOLIZATION OF α,β -DIARYL- β -HYDROXY ACIDS

(Publication No. 21,353)

Martin Eugene Rowley, Ph.D.
University of Michigan, 1956

This study determined the relationship between the structure and stability to base of α,β -diaryl- β -hydroxy acids (I). A mechanism for the base-catalyzed cleavage of I to a ketone and an arylacetic acid (equation 1) was proposed.



Twelve β -hydroxy acids were prepared by treating arylacetic acid with two moles of isopropylmagnesium chloride, followed by the addition of the appropriate ketone. The cleavage reaction was catalyzed by sodium hydroxide or sodium propoxide, the former in aqueous 1-propanol and the latter in anhydrous 1-propanol. The ionic strength was adjusted with sodium perchlorate. The rates of cleavage were followed dilatometrically; the temperature was regulated within $\pm 0.003^\circ$. The observed pseudo-first-order rate constants (k_1) were calculated from the conventional Guggenheim plot. The second-order rate constants (k_2) were obtained by dividing k_1 by the base concentration. The rate constants were reproducible to within 4%.

The reaction rate was very nearly equal to $k_2 [\text{OH}^-]$ [acid anion] as determined for the reference compound, α,β -diphenyl- β -hydroxybutyric acid. The reaction was pseudo-first-order, since there was no change in base concentration during the reaction.

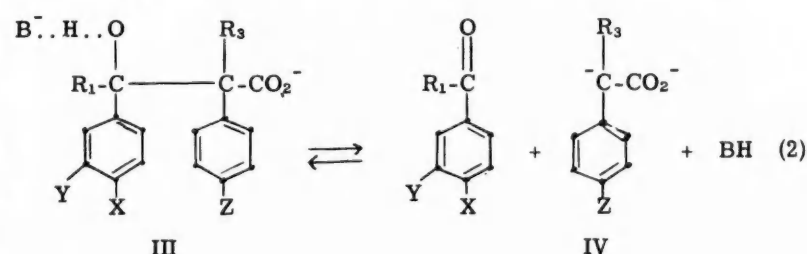
Structural - The rate increased when Z (structure I) was electron-withdrawing and decreased when Z was electron-releasing. This indicated a high electron density on the α -carbon in the transition state. The rate increased when X or Y exerted a -I effect. The dominant factor was thought to be an inductive electron attraction which increased the acidity of the hydroxyl hydrogen. However, a contribution from stabilization of the developing ketone II by conjugation with some *para* substituents was evident; chlorine gave a greater increase in the *para* position (X) than in the *meta* (Y). Increasing the bulk of R_3 resulted in a large increase in rate. This was attributed to the F-strain produced about the $C_\alpha-C_\beta$ bond, and cleavage relieved this strain. The bulk effect masked any electrical effect of R_3 . When the +I effect and bulk of R_1 (alkyl) were increased, the rate decreased; R_1 = phenyl (-I) produced a larger decrease. Both the electronic (altering acidity of the hydroxyl hydrogen) and bulk effects (hindrance to attack by base) of R_1 appeared to be operative. When R_1 was hydrogen, a competing reaction prohibited rate determinations. An ester of α -phenyl- α -(1-hydroxycyclohexyl) acetic acid cleaved much faster than the acid. The two racemates of an acid cleaved with identical rates.

Environmental - A large positive salt effect was

indicative of the interaction of two like-charged (negative) ions. Increasing the percentage of 1-propanol (aqueous propanol solvent medium) gave an increase in rate, with large increases from 95-100%. This increase was attributed to the increasing proportion of propoxide ion (stronger base than hydroxide). Sodium propoxide cleaved the reference compound too fast for measurement.

All the acids I were cleaved at two or three temperatures and the Arrhenius plot indicated ΔH^\ddagger to be very nearly the same for all acids I. No significant trends were observed in the ΔS^\ddagger values.

Mechanism - A "concerted" mechanism for the cleavage reaction best explains the results. That is, bond-forming (B-H) and bond-breaking (O-H and $C_\alpha-C_\beta$) occur



at practically the same time. The rate-determining step (equation 2) is the simultaneous elimination of BH and the doubly-charged anion IV from the transition complex III.

113 pages. \$2.00. Mic 57-1956

p-METHOXYPHENYLMALEIC ANHYDRIDE IN THE DIELS-ALDER REACTION

(Publication No. 20,887)

Henn Ruus, Ph.D.
University of Illinois, 1957

p-Methoxyphenylmaleic anhydride was prepared using *p*-methoxybenzyl alcohol as the starting material. This was converted to *p*-methoxybenzyl chloride by reaction with hydrogen chloride, and treatment of the chloride with sodium cyanide gave *p*-methoxyphenylacetonitrile. The latter was condensed with ethyl formate and to the resulting -formyl-*p*-methoxyphenylacetonitrile, hydrogen cyanide was added to the carbonyl group. After addition of acetic anhydride the two isomeric *threo* and *erythro* forms were isolated. Acetic acid was eliminated from the molecules by treatment with aqueous sodium bicarbonate solution. The resulting *p*-methoxyphenylmaleonitrile and *p*-methoxyphenylfumaronitrile were separated by crystallization. Hydrolysis of *p*-methoxyphenylmaleonitrile and *p*-methoxyphenylfumaronitrile with polyphosphoric acid gave *p*-methoxyphenylmaleic anhydride.

Attempts to prepare phenylmaleic anhydride from benzalmalononitrile using cyanogen bromide failed.

That *p*-methoxyphenylmaleic anhydride does participate in the Diels-Alder reaction as a dienophile was demonstrated by the formation of adducts with 1,3-butadiene, 2,3-dimethyl-1,3-butadiene, and cyclopentadiene, which gave one adduct diacid in each case. The anthracene adduct was isolated as an anhydride. In the case of three unsymmetrical

dienes two products were isolated from each reaction mixture. That the products isolated in each case were structural isomers rather than stereoisomers was shown by the degradation of the isoprene adduct to the known 4-methoxy-4'-methylbiphenyl and the degradation of one of the 2-ethyl-1,3-butadiene adducts to the known 4-hydroxy-4'-ethylbiphenyl. The structures of the other products in the reaction of *p*-methoxyphenylmaleic anhydride with isoprene and 2-ethyl-1,3-butadiene and of both products with 2-isopropyl-1,3-butadiene were assigned by analogy with the results obtained by Miller and Mann (1) with phenylmaleic anhydride and the same dienes and by comparison of the infrared absorption spectra.

In the Diels-Alder reaction with 1-vinylnaphthalene *p*-methoxyphenylmaleic anhydride participates as a diene. That the adduct was 4-(1'-naphthyl)-7-methoxy-1,2,3,4-tetrahydronaphthalene-1,2-dicarboxylic acid was shown by an independent synthesis of the latter from 1-(α -naphthyl)-1-*m*-methoxyphenylethylene and maleic anhydride.

The dimethyl esters of the 1,3-butadiene, 2,3-dimethyl-1,3-butadiene and 1-vinylnaphthalene adducts were prepared using an ethereal solution of diazomethane.

When 1-(*p*-methoxyphenyl)-4-methylcyclohex-1-ene and 1-(*p*-methoxyphenyl)-4-ethylcyclohex-1-ene were dehydrogenated with 30% palladium on carbon, it was found demethylation also occurred, and the products were the corresponding 4-hydroxy-4'-methylbiphenyl and 4-hydroxy-4'-ethylbiphenyl.

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THE EFFECT OF POLYAMINE POLYACETATE METAL CHELATING AGENTS ON THE ABSORPTION OF MINERAL ELEMENTS BY PLANTS

(Publication No. 21,453)

James Henry Sayles, Jr., Ph.D.
The Ohio State University, 1956

The effect of applying natural and synthetic metal chelating agents to different soil types on the growth and absorption of mineral elements by plants has been investigated.

The data show that the effect was different with the different metal chelating agents, rates of application, soil types, and pH levels.

The application of citric acid and tartaric acid did not significantly affect the absorption of phosphorus by plants grown in different soils. However, tetrasodium ethylenediaminetetraacetate (Na₄EDTA), sodium N, N-di(2-hydroxyethyl)glycine (NaDHG), and trisodium N-hydroxyethylethylenediaminetriacetate (Na₃EDTA-OH) increased the uptake of phosphorus by corn. The effect of these latter materials was influenced by soil type, soil pH, and rates of application.

Iron absorption by the plants was significantly affected by the application of Na₄EDTA, NaDHG, and Na₃EDTA-OH in the case of only one of the soils. In this instance, the

relation between the absorption of iron and phosphorus, and extractable iron and phosphorus, was found to coincide with the metal chelating properties of these substances. Particularly was this true for Na₄EDTA and NaDHG.

Manganese absorption was also significantly affected by applications of Na₄EDTA, Na₃EDTA-OH, and NaDHG. In general, the increases in manganese absorption over the checks were slightly greater for NaDHG than for the other synthetic metal chelating agents.

The magnesium and potassium content of the plants was not significantly affected by the application of Na₄EDTA, Na₃EDTA-OH, or NaDHG. However, Na₄EDTA and NaDHG did significantly increase the calcium content of the plants grown in two of the soils. Calcium absorption was considerably greater at the high pH levels than at the low pH levels. The effect of pH on calcium absorption was independent of soil types.

There was no significant difference between the main effects of Na₄EDTA and NaDHG on the absorption of calcium by plants. However, there was an increase in the calcium content of the plant tissue with increasing rates of application of these materials.

Na₄EDTA, Na₃EDTA-OH, and NaDHG extracted increasing amounts of calcium, magnesium, potassium, iron, and phosphorus from the soils as the concentrations of the extracting solutions increased. The amounts of these elements were not reliable estimates of the availability of calcium, magnesium, potassium, iron, and phosphorus to plants.

Citric acid, tartaric acid, tetrasodium ethylenediaminetetraacetate, trisodium N-hydroxyethylethylenediaminetriacetate, and sodium N,N-di(2-hydroxyethyl)glycine were effective in reducing the amount of soluble phosphorus fixed by the soils against extraction with 0.02 N H₂SO₄.

Citric acid and tartaric acid did not have any apparent influence on the growth of sudan grass. However, Na₄EDTA, Na₃EDTA-OH, and NaDHG had a remarkable effect on the growth of corn, particularly at the 250 and 500 pounds per acre rates. The growth effects of Na₄EDTA, Na₃EDTA-OH, and NaDHG were independent of soil types.

Na₄EDTA, Na₃EDTA-OH, and NaDHG had a toxic effect on plants when applied to soils at rates of 1000 pounds per acre. The upper tolerance level of corn (K-24) for these substances appears to be between 500 and 1000 pounds per acre. 117 pages. \$2.00. Mic 57-1958

PART I: THE REACTION OF METALS AND OF IODIDE ION WITH 1,2- AND 1,4-DIHALIDES

PART II: SPECTRAL STUDIES OF PARA-HALOGEN SUBSTITUTED NITROBENZENES AND ACETOPHENONES

(Publication No. 21,211)

Harvey Steadly, Ph.D.
University of Washington, 1957

Part I

A study of the steric course of the debromination of *meso*-1,2-dibromo-1,2-dideuteroethane with iodide ion was undertaken and found to be one of exclusive over-all

cis elimination. It was concluded that the debromination proceeded by a rate-controlling step of S_N2 displacement by iodide ion, followed by a faster step of *trans* elimination on the intermediate bromoiodide.

Part II

The ultraviolet excitation energy for excitation to a dipolar state (E-band) was measured for *p*-halonitrobenzenes and *p*-haloacetophenones in both the gas-phase and in a variety of solvents. It was concluded that halogen atoms destabilize the ground state of nitrobenzene and of acetophenone in the order F(greatest) > Cl > Br > I, and stabilize the excited state in the opposite order. It was also concluded that, in addition to the solvation of the functional group (nitro or acetyl) in the order I(greatest) > Br > Cl > F, ring solvation is of importance, in the order F(greatest) > Cl > Br > I.

With the aid of a new linear free energy relationship, it appears that one of the assumptions of the Hammett equation, namely, that the reaction "constant" is independent of the substituent, is probably invalid. Also, that the only true substituent constant is the polarizability. In addition, it is suggested that the halogen atom is considered to act as a single unit so that it is not necessary to consider both induction (for electron withdrawal) and resonance (for electron release). An explanation of the data can be made in terms of the polarity and polarizability of the halogen atoms.

107 pages. \$2.00. Mic 57-1959

THE USE OF THE BORON TRIFLUORIDE-DINITROGEN TETROXIDE COMPLEX AS A NITRATING AGENT

(Publication No. 21,320)

Clifford Marshall Vogt, Ph.D.
Purdue University, 1957

Major Professor: G. Bryant Bachman

This investigation was concerned with the use of the boron trifluoride-dinitrogen tetroxide complex ($BF_3 \cdot N_2O_4$) as a nitrating agent. Previous work has shown that boron trifluoride and dinitrogen tetroxide combine in a ratio of 1/1, forming a solid product with the probable ionic structure $(NO_2)^+ (BF_3 : NO_2)^-$, and that the complex is a nitrating agent for aromatic compounds. The present work was undertaken to study more extensively its use in nitration.

The complex is easily prepared at 0° by passing gaseous boron trifluoride into liquid dinitrogen tetroxide in solvents such as nitroparaffins or polychlorinated hydrocarbons. It is quite stable over indefinitely long periods of time when preserved in stoppered containers in the absence of moisture or other reactive substances.

A comparison was made of its nitrating strength relative to that of nitric acid. Results of relative rate studies show it to be comparable in nitrating power for aromatic compounds to nitric acid. However, it gives a higher ratio of di- to mono-nitration than the latter reagent.

The complex can be used satisfactorily to nitrate a number of aromatic compounds which behave anomalously with nitric acid. Thus, methyl and isopropyl groups

attached to an aromatic ring are unaffected by this complex, whereas these groups are very susceptible to oxidation in the presence of nitric acid. This complex also has been used successfully in the nitration of compounds which give poorer yields of the expected products, e.g. thymyl ethers, alkylmalonic esters, etc.

The complex gives a different ratio of isomers than is obtained with nitric acid under comparable conditions. Larger percentages of ortho nitration were observed in reactions with chlorobenzene and o-nitrotoluene. This selectivity of the ortho over the para position is occasionally advantageous in the nitration of benzene derivatives.

The complex is especially suitable for nitrations which are advantageously run in nonpolar solvents, such as chloroform, nitroparaffins and petroleum ether. It is not soluble to any appreciable extent in these solvents, so that nitration may be stopped by pouring off the solvent-reactant mixture from the solid complex. The complex is decomposed by solvents or reactants which are sufficiently basic to separate the BF_3 from the N_2O_4 , including those containing hydroxy, ether and amino groups.

In the aliphatic series some compounds are nitrated and others are merely oxidized. Nitro groups have been successfully introduced by reactions of methylmalonic ester and sodium 2-propanenitronate with the complex. On the other hand ethers give only oxidation products, dibutyl ether yielding butyl butyrate.

The complex constitutes a useful new nitrating agent in the list of substances available to the synthetic organic chemist.

162 pages. \$2.15. Mic 57-1960

REARRANGEMENT AND OTHER STUDIES OF SOME ORGANIC DERIVATIVES OF DICYCLOPENTADIENYLIRON

(Publication No. 21,420)

Norman Weliky, Ph.D.
Polytechnic Institute of Brooklyn, 1957

Dicyclopentadienyliron (ferrocene) was reported, in 1951, to be the first organometallic derivative of iron to be identified. It was quickly discovered that the iron was centrosymmetrically placed between two cyclopentadienyl rings, and that the resulting molecule could be acylated under Friedel and Crafts conditions.

With this as background, it was decided to incorporate the ferrocene nucleus into various organic compounds, and observe the effects of doing so on the properties of these compounds. Di-*p*-chlorobenzoylferrocene and di-phenylacetyl-ferrocene were made first, but it was decided, after some experimentation, to use monobenzoylferrocene as a starting material because it has only one functional group.

Monobenzoylferrocene was converted to its oxime which rearranged, under Beckmann conditions, to the anilide of ferrocenecarboxylic acid. The anilide was identified by independent synthesis. The direction taken by the rearrangement determined that the oxime had an *anti*-phenyl configuration, implying that steric effects of the unsubstituted ferrocene ring were minor.

Reduction of monobenzoylferrocene by methylmagnesium bromide, in the presence of anhydrous cobalt chloride, yielded a pinacol which rearranged to a pinacolone

with extraordinary ease in benzene solution, on exposure to hydrogen chloride gas. Benzoic acid and phenyl-(bis-ferrocenyl)-methane resulted from alkaline degradation of the pinacolone. This established that ferrocene migrated. The pinacol had still another interesting feature. On standing, it was reoxidized to monobenzoylferrocene, in many solvents, possibly by a free radical mechanism.

Phenylferrocenyl carbinol, obtained from monobenzoylferrocene by reduction with lithium aluminum hydride, also showed unusual reactivity. It formed a methyl ether with remarkable ease, and under halogenation or esterification conditions, seemed to form di-phenyl-ferrocenyl-methyl ether.

From reductions of monobenzoylferrocene by zinc, sodium and magnesium-magnesium iodide, under various conditions, phenylferrocenylmethane, phenyl-(bis-ferrocenyl)-benzoylmethane and several products, not as yet positively identified, were isolated. Phenylferrocenylmethane, unlike ferrocene, formed a yellow solution in concentrated sulfuric acid which turned blue if an oxidizing agent was added.

The conclusions drawn from these studies were:

1. Due to the distance between ferrocene rings (about 3.2 Å) and the probable planarity of the oxime group with the rings to which it is bonded, there is little interference of the unsubstituted ferrocene ring with orientation of the oxime group of monobenzoylferrocene oxime.
2. Ferrocene units act as groups of high electron density in carbonium ion reactions. The ease of migration of ferrocene in the pinacol rearrangement, despite the crowding of two ferrocene groups and a phenyl group onto one carbon, suggests that in this case steric factors again do not have a major effect. 82 pages. \$2.00. Mic 57-1961

THE PEROXY ACID OXIDATION OF ORTHO-SUBSTITUTED ARYL KETONES

(Publication No. 21,322)

Donald Paul Wiesler, Ph.D.
Purdue University, 1957

Major Professor: William E. Truce

This investigation was concerned with finding out what factors influence reactivity in the oxidation of ortho-substituted aryl ketones to the corresponding esters. 2-Methoxybenzophenone was found to be very reactive toward peracetic acid, giving 2-methoxyphenyl benzoate, but 2-methoxy-2'-methylbenzophenone was less reactive under similar conditions. Benzophenone has been reported to give a high yield of phenyl benzoate, but under even more vigorous conditions 2,2'-dimethylbenzophenone was found to be almost completely unreactive.

The effects considered most important in hindering reactivity are a steric effect associated with an increase in coordination number from three to four in the addition of peracetic acid to the carbonyl group, and a resonance effect caused by electron-donating substituents in the ortho position. The steric effect is probably not important in influencing migratory aptitude, nor does it seem to be as great for an *o*-methoxy group as for *o*-methyl and others.

The resonance effect appears important only if the polarized form of the ketone assumes an anthracenoid or similar structure, as evidenced by the reported non-reactivity of xanthone as compared with the observed reactivity of its open-chain analog, 2,2'-dimethoxybenzophenone.

Chromone, an analog of xanthone, underwent attack at the heterocyclic nucleus rather than the carbonyl group, giving 3-chromonol. Its saturated analog, 4-chromanone, underwent normal reaction, in which β -(*o*-hydroxyphenoxy) propionic acid was isolated directly instead of the corresponding seven-membered ring lactone.

Steric hindrance may also account for the non-reactivity of 10,10-dimethylantrone, thiaxanthone dioxide, and anthraquinone, though in the latter two compounds low migratory aptitude due to electron-withdrawing substituents in the ortho position can reasonably be blamed for the result. 109 pages. \$2.00. Mic 57-1962

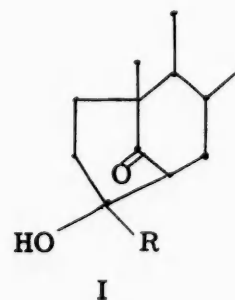
A NEW REARRANGEMENT INVOLVING THE GRIGNARD REAGENT

(Publication No. 20,356)

Kenneth Dean Zwahlen, Ph.D.
University of Utah, 1957

Chairman: Dr. W. J. Horton

It has been reported previously that certain steroid enol lactones react with only one mole of methylmagnesium halide to give a compound of unproven structure. This same compound was obtained in this study using dimethylcadmium in the place of the Grignard reagent. To determine its structure, the addition compound was reduced with lithium aluminum hydride. The reduced product was a diol which was resistant to acetylation and which formed a cyclic sulfite ester when treated with thionyl chloride. The observations are discussed with respect to several possible structures and are found to be consistent only with a bridged, bicyclic keto-alcohol (I). An attempted synthesis of this bridged compound was unsuccessful.

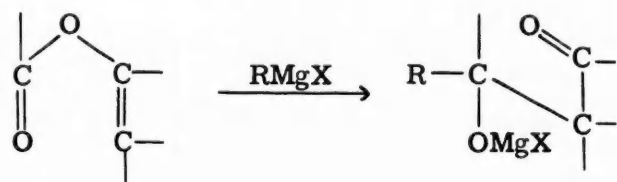


A three ring steroid-model enol lactone was prepared and treated with phenylmagnesium bromide. The product was shown to be a bridged, bicyclic keto-alcohol which was confirmed by an independent synthesis. This enol lactone was treated with methylmagnesium iodide; the same rearrangement to a bridged, bicyclic system took place, but a second mole of Grignard reagent added to the rearranged product and a diol was isolated.

This rearrangement was further substantiated by treating simple enol acetates with Grignard reagents. In

each case migration of the acetyl group was observed with addition of two moles of Grignard reagent to produce 1,3-diols. These were compared with the known compounds.

A possible mechanism for this rearrangement is discussed. It is concluded that in general the reaction of Grignard reagents with enol lactones and enol esters involves a migration of the carbonyl carbon to the ethylenic carbon α to the enolic oxygen with simultaneous addition of the Grignard reagent across the carbonyl group. At the same time the acyl to oxygen bond is broken allowing the enol to tautomerize into the keto form. In some cases a second mole of Grignard reagent reacts with the rearranged product.



75 pages. \$2.00. Mic 57-1963

CHEMISTRY, PHYSICAL

THE PHOTOREDUCTION OF BOUND DYES

(Publication No. 21,414)

Judith S. Bellin, Ph.D.

Polytechnic Institute of Brooklyn, 1957

It was the purpose of this investigation to examine the detailed kinetics of the photoreduction of triphenylmethane and fluorescein-type dyes when bound to high-polymeric substrates. The rate of photoreduction by ascorbic acid of bound dye molecules was investigated as a function of the degree of binding, dye concentration, reduction concentration and light intensity.

Triphenylmethane dyes do not undergo photoreduction at all unless they are bound to water-soluble high polymeric substrates. The rates of photoreduction of fluorescein-type dyes are considerably increased upon binding of these dyes to polyvinylpyrrolidone. In contrast, the reduction of these dyes in the dark by strong reducing agents is actually inhibited when the dyes are bound.

In several respects the photochemical behavior of the bound dyes is different from that of free fluorescein-type dyes. Whereas, with the latter, when free, the quantum yield of photoreduction decreases with increasing dye concentration, for bound dyes the quantum yield increases with increasing dye concentration. Nitrobenzene retards the rate of fading of free dyes, while in the case of bound dyes the reaction is inhibited until all the nitrobenzene is consumed, after which the reaction proceeds at a rate equal to that for the inhibitor-free system.

p-Phenylenediamine and potassium iodide retard the photoreduction of free fluorescein-type dyes. They are without effect on the rate of photoreduction of bound triphenylmethane dyes, but do have a marked effect on the photoreduction of bound fluorescein-type dyes. p-Phenylenediamine causes a period of inhibition, after which the

reaction proceeds at a reduced rate compared to that of the inhibitor-free system. Both the duration of the inhibition period and the amount of retardation are proportional to the amount of p-phenylenediamine added. Potassium iodide, at concentration less than 3×10^{-3} mol./l. increases the rate of photoreduction of bound fluorescein-type dyes; at higher concentrations it exerts a retarding effect.

Analysis of the kinetic data shows that bound long-lived excited dye molecules react with the reductant to give colorless products. Interaction between bound dye molecules in the ground state and those in the first electronically excited singlet state is the principal mechanism for the formation of long-lived dye molecules. Confirmation of this reaction step is the fact that self-quenching of the fluorescence of bound dye molecules occurs at abnormally low dye concentrations. 121 pages. \$2.00. Mic 57-1964

KINETICS OF GRAPHITE OXIDATION

(Publication No. 18,707)

George Donald Blyholder, Ph.D.

University of Utah, 1956

Chairman: Henry Eyring

A description of an apparatus for studying heterogeneous gas-solid reactions in the one to one hundred micron pressure and 600°C to 1300°C temperature range is presented. The data for the graphite-oxygen reaction in this range are presented. Below 800°C the surface reaction is zero order with an 80 kcal per mole activation energy. On samples thicker than 0.1 mm., the diffusion of oxygen into the pores in the graphite results in an observed half order reaction with a 42 kcal per mole activation energy. Above 1200°C the reaction is controlled by the frequency of oxygen collisions with the surface. Between 800°C and 1200°C a continuous transition region exists. An equation is derived which gives the reaction rate under conditions in which pore diffusion affects the observed reaction rate and the surface reaction varies with the pressure in a manner described by the Langmuir adsorption isotherm. A great deal of the literature on carbon oxidation deals with materials which have been carbonized but not graphitized. These materials are usually oxidized in first order reactions with an activation energy of 20 to 30 kcal per mole. A kinetic treatment is given which explains the maximum in the Arrhenius plot observed by many workers engaged in the oxidation of electrically heated, carbonized filaments. 80 pages. \$2.00. Mic 57-1965

CONTACT ANGLES AS INFLUENCED BY
ADSORPTION AT THE PHASE BOUNDARIES;
ADSORPTION AT INTERFACES FORMED BY
MERCURY, WATER, AND ORGANIC LIQUIDS

(Publication No. 21,151)

Philip Daniel Bouffard, Ph.D.
University of Michigan, 1955

The well-known Young's equation expresses the conditions of equilibrium which must exist between the angle of contact formed by a drop of liquid resting upon a substrate and the boundary tensions which exist between each of the three phases of the system. For a three-phase water-organic liquid-substrate system the equation may be written as follows:

$$\cos \Theta = \frac{\gamma_{SO} - \gamma_{SW}}{\gamma_{WO}} \quad (1)$$

in which γ_{SO} is the interfacial tension between substrate and organic liquid,

γ_{SW} is the interfacial tension between substrate and water,

γ_{WO} is the interfacial tension between water and organic liquid,

and Θ is the angle of contact measured through the water phase.

Very little work has been done in an attempt to relate the angles of contact with the three interfacial tensions existing within such a system, probably for the reason that it is impossible to measure directly the tension existing between a fluid and a solid substrate. Recently, Bartell and Bjorklund (J. Phys. Chem., 56, 453 (1952)), by using mercury as a substrate together with water and benzene, were able to measure the three interfacial tensions of this system and were able also to relate the determined interfacial tensions with the angle of contact and found good agreement with the Young's formulation. Inasmuch as practical problems dealing with wetting properties of solutions is of much importance it was believed that a study of systems in which solutions instead of pure liquids were used with the liquid substrate, mercury, might be of considerable importance.

In the present research systems consisting of mercury as the substrate with two liquid phases, one of which was a solution, were used. The systems studied in this research were:

1. mercury-water-toluene + bromobenzene
2. mercury-water-toluene + nitrobenzene
3. mercury-water-n-heptane + toluene
4. mercury-water-n-heptane + bromobenzene
5. mercury-water-n-heptane + nitrobenzene
6. mercury-aqueous 1 N NaOH-n-heptane
7. mercury-aqueous 1 N HCl-n-heptane
8. mercury-aqueous 1 N AlCl₃-n-heptane.

The organic liquid solutions used covered the entire concentration range between the two pure components.

Interfacial tensions at each boundary were determined using the pendent drop technique. Contact angle values for each system were obtained using the controlled drop

method. Observed and calculated contact angle values were found to agree reasonably well except for those systems in which the contact angle approached a value of 180°. It was shown, however, that at this range of values small errors in any of the determined interfacial tension values would produce errors in the calculated contact angles of considerable magnitude.

The dependence of the angle of contact upon differences in values of the three interfacial tensions was shown by taking the differential form of equation (1).

$$d\Theta = - \frac{1}{\gamma_{WO} \sin \Theta} \left[d(\gamma_{SO}) - d(\gamma_{SW}) - \left(\frac{\gamma_{SO} - \gamma_{SW}}{\gamma_{WO}} \right) d(\gamma_{WO}) \right] \quad (2)$$

From this equation one observes that the differences in the contact angle values are dependent not only upon the magnitudes of the interfacial tension differences, $d(\gamma_{SO})$, $d(\gamma_{SW})$, and $d(\gamma_{WO})$, but, because of the appearance of the term $1/\sin \Theta$, depend upon the magnitudes of the contact angles when the changes occur, and upon the magnitude of the interfacial tension γ_{WO} , which appears in every term on the right-hand side of equation (2).

It can be seen from equation (2) that the change in the contact angle, $d\Theta$, produced by a given change in interfacial tension would be less for high than for low values of γ_{WO} , and also that $d\Theta$ would be greater when the contact angle before alteration approached 0° or 180°, i.e., when $\sin \Theta \rightarrow 0$ and $1/\sin \Theta \rightarrow \infty$, than it would be for an original contact angle of intermediate value, since as $\Theta \rightarrow 90^\circ$, $\sin \Theta \rightarrow 1$, and $1/\sin \Theta \rightarrow 1$.

The experimentally determined contact angle values obtained in this research were in good agreement with the results which were predicted from a consideration of equations (1) and (2) and the experimental data for the boundary tensions.

102 pages. \$2.00. Mic 57-1966

THE CRYSTAL STRUCTURE OF DECANAMIDE

(Publication No. 21,198)

James Robert Brathovde, Ph.D.
University of Washington, 1957

The molecular and crystal structure of decanamide was investigated by X-ray diffraction techniques using 2-dimensional F_o and $(F_o - F_c)$ Fourier syntheses. Compensations for individual atomic vibrations were included by using individual anisotropic temperature factors.

The appendix includes a detailed set of instructions and wiring diagrams for an IBM Type 604 Electronic Calculator when used to perform the necessary calculations for X-ray diffraction crystal structure determinations.

150 pages. \$2.00. Mic 57-1967

THE MOLECULAR STRUCTURE OF B_9H_{15}

Publication No. 21,242)

Richard Earl Dickerson, Ph.D.
University of Minnesota, 1957

The structure of a new boron hydride has been studied by x-ray diffraction techniques, and the compound found to be B_9H_{15} . No initial chemical data were available other than melting point ($-20^\circ C$) and chemical elements (B and H only). Single crystal precession and Weissenberg photographs yielded 374 observed reflections. The space group is monoclinic, $P2_1/n$, with four molecules per unit cell. Unit cell parameters are: $a = 11.80 \text{ \AA}$; $b = 6.94 \text{ \AA}$; $c = 11.25 \text{ \AA}$; $\beta = 109^\circ 9'$.

The boron skeleton was elucidated from the three-dimensional Patterson function and systematic trial and error methods using the Univac Scientific 1103 electronic computer, and refined by the method of least squares. The skeleton was found to be the fragment of an icosahedron with boron vertices obtained by removing three adjacent borons not forming a triangle. Hydrogen atoms were located from three-dimensional Fourier difference maps, and their positions found to agree fully with theories derived from known boron hydride structures. Final overall agreement factor was $R = \frac{\sum ||F_o| - |F_c||}{\sum |F_c|} = .1551$.

Computational methods for structure factors, Fourier synthesis and least squares using the Univac Scientific 1103 are described, and the significance of partial shifts in least squares refinement discussed. The least squares normalized weighted sum of squares of residuals, r , is proposed as a better criterion of the fit of a model to data than R , the normalized sum of residuals, and comparisons of r and R are given throughout.

A semi-topological approach to the structure of boron hydrides is discussed in some detail as an extension of the equations of orbital and electron balance of Eberhardt, Crawford and Lipscomb, particularly in connection with presently unknown hydrides. The probable hydrogen arrangement in B_9H_{10} is predicted and it is shown that:

1) If a B_8 hydride whose framework is an icosahedral fragment, then it will probably have twelve or fourteen hydrogens.

2) B_9H_{13} and hydrides with seven borons are unlikely with structures resembling the known boron hydrides.

61 pages. \$2.00. Mic 57-1968

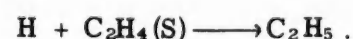
LIFETIMES FOR DECOMPOSITION
OF VIBRATIONALLY EXCITED
DIDEUTEROETHYL RADICALS

(Publication No. 21,201)

Donald Hobert Dills, Ph.D.
University of Washington, 1957

The lifetime and h/d bond rupture probability of ethyl- d_2 , energized by the 39 kcal exothermic reaction of hydrogen atoms with trans-ethylene- d_2 , has been measured over the temperature range -80° to 160° and at pressures of from 0.1 mm to 1 mm, by comparing the amount of exchange and isomerization with the kinetic theory rate of

collisions under conditions such that all H atoms (originating at a point source at the center of a spherical reactor through an effusion leak from a Wood-Bonhoeffer discharge tube) disappear in the gas phase. It is shown that isomerization and exchange do not arise from reactions other than the unimolecular decomposition of energetic ethyl- d_2 . The ratio of disproportionation to recombination of ethyl under the conditions used is 0.11; the evidence of this study is that disproportionation does not take place by a "head-to-tail" mechanism. In the presence of ethylene, and at a glass surface, hydrogen atoms disappear very fast by a reaction of the sort:



It is found that H_2 is as effective as ethylene for deactivating energetic ethyls. The results agree with the model of a random (first order rate) energetic ethyl lifetime.

The radical lifetime as a function of temperature can be fitted to the Kassel-Slater equation:

$$k = \bar{v}((\epsilon - \epsilon_0)/\epsilon)^r,$$

but it is found that the value of the exponent, r , is of a different order of magnitude than that predicted by the Slater theory of unimolecular reactions. The h/d rupture ratio agrees with that predicted by the transition state theory of isotopic reactions. 97 pages. \$2.00. Mic 57-1969

THE EFFECT OF WATER IN THE
CATIONIC POLYMERIZATION OF
STYRENE BY STANNIC CHLORIDE.
A KINETIC STUDY.

(Publication No. 21,415)

Raymond J. Ehrig, Ph.D.
Polytechnic Institute of Brooklyn, 1957

The purpose of the research described here was to determine the effect of variation of the concentration of water on the rate and molecular weight in the polymerization of styrene catalyzed by a Lewis acid. It was also desirable to obtain the kinetic order of the initial reaction at a known concentration of water in order to gain information concerning the mechanistic role of water in the polymerization.

The particular system chosen for study was the polymerization of styrene at $25^\circ C$. in the presence of stannic chloride in nitrobenzene-carbon tetrachloride solvent mixtures. The rate of polymerization was followed dilatometrically and a high vacuum technique was employed for introduction of reagents into the dilatometer. These reagents were dried under stringent conditions. Exploratory studies indicated that the reaction was heterogeneous at low water concentrations in solvent media of low dielectric constant (5 and 15% nitrobenzene) and variable induction periods were observed. It was also found that in a 15/85% mixture of nitrobenzene-carbon tetrachloride solvent, the rate increased rapidly with increasing water concentration reaching a maximum value at a 1:4 molar ratio of water to stannic chloride. A mixture of the dry reagents gave a negligible rate. The molecular weight of the polymer was observed to decrease with increasing concentrations of water.

A more detailed investigation of the polymerization reaction was made in a 30/70% mixture of nitrobenzene-carbon tetrachloride solvent. Upon mixing the dry reagents a slow reaction occurred. The rate was again observed to increase and the molecular weight to decrease as the concentration of water was increased. A maximum rate occurred at a 1:1 molar ratio of water to stannic chloride, and then decreased with further addition of water. The decrease in rate has been partly attributed to heterogeneity. The reaction was also found to be first order with respect to the catalyst concentration, and second order with respect to the monomer concentration at a constant water concentration of 0.005 M. No induction periods were observed during the investigation.

Thus, the results indicated that water is required as a cocatalyst for the reaction and that both the rate and the molecular weight of the polymer is dependent upon the water concentration.

The following reaction mechanism has been proposed to account for the results obtained. An initiation process involving a catalyst-cocatalyst (monohydrate) complex is suggested, followed by the usual carbonium ion mechanism for growth of the polymer chain. Termination is assumed to occur by a spontaneous unimolecular process and a bimolecular process involving water. A monomer transfer step is also postulated.

The rate of the initial reaction and the degree of polymerization have been expressed by the following equations in which all reagents are expressed as initial concentrations:

$$-\frac{d(M)}{dt} = \frac{Kk_i k_p (\text{SnCl}_4)(\text{H}_2\text{O})(M)^2}{k_{t_1} + k_{t_2}(\text{H}_2\text{O})}$$

$$\bar{P}_n = \frac{k_p(M)}{k_{t_1} + k_{t_2}(\text{H}_2\text{O}) + k_{tr}(M)}$$

In the above expressions, (M) is the monomer concentration, K is an equilibrium constant for the association of stannic chloride and water, and k_i , k_p , k_{t_1} , k_{t_2} , and k_{tr} are the velocity constants for initiation, propagation, unimolecular termination, bimolecular termination, and transfer respectively.

Various ratios of rate constants have been derived from the results obtained and are included herein.

154 pages. \$2.05. Mic 57-1970

A LIGHT-SCATTERING INVESTIGATION OF THE INTERACTION OF POLY-4- VINYL-N,N-BUTYL-PYRIDINIUM BROMIDE AND BOVINE SERUM ALBUMIN

(Publication No. 21,433)

David Edward Erickson, Ph.D.
The Ohio State University, 1956

In an investigation of the macromolecular interaction of poly-4-vinyl-N,N-butyl-pyridinium bromide (PVP) and bovine serum albumin (BSA), the method of angular light scattering was used to obtain information about the molecular weight, size, and shape of the complexes formed. pH

titrations gave some information from which possible models for the interaction were postulated. The light-scattering data were further utilized in the calculation of an intrinsic association constant for the relatively weak complexes formed.

The PVP molecule is a random coil in solutions of moderate ionic strength, but it approaches a rodlike shape in solutions of low ionic strength, while the BSA molecule is ellipsoidal, with an axial ratio of about four to one. The PVP used had a weight-average molecular weight of 3.8×10^5 , while the BSA was found to have a weight-average molecular weight of 8.22×10^4 . An analysis of the pH titration curves resulting from the titration of BSA with PVP indicates that at high weight-mixing ratios of BSA to PVP the interaction complexes are composed of a rodlike backbone of PVP surrounded by a sheath of BSA molecules whose long axes are perpendicular to the PVP chain. As the proportion of PVP in solution is increased, the orientation of BSA on PVP changes to one in which the long axes of the BSA molecules are oriented in a parallel manner to the PVP chains so that, finally, only one BSA is bound to any given region of the PVP. An investigation of the weight-mixing ratios, where these phenomena occur, led to information about the minimum and maximum numbers of sites on PVP engaged in binding one BSA molecule.

All light-scattering runs were made on solutions in which the BSA molecules were thought to be attached with their long axes parallel to the PVP chain at intervals along the chain. Values of δ , the weight-binding ratio of BSA to PVP in the complexes, B, the osmotic pressure second virial coefficient, and R_G , the radius of gyration of the complex, were calculated for each run. All evidence pointed toward electrostatic binding in the complexes and a strong dependence of radius of gyration on the ionic strength of the system but not on the number of BSA molecules bound.

Light-scattering data showed that the PVP was quite polydisperse, having $M_N:M_W:M_Z::1:2.08:4.26$. The interaction complexes showed about the same degree of polydispersity.

In addition, the light-scattering data showed that the complexing was quite weak. An attempt was made to calculate the intrinsic association constant by treating the multiple equilibria involved, and a value of 5×10^5 liters per mole was obtained. However, this constant was not free of electrostatic effects.

130 pages. \$2.00. Mic 57-1971

THE INFRARED SPECTRUM OF A SINGLE CRYSTAL OF 1,2-DICHLOROETHANE

(Publication No. 21,115)

Murray Gershenzon, Ph.D.
Columbia University, 1957

Thin oriented sections of crystalline 1,2-dichloroethane were grown from the vapor phase in an apparatus designed to permit spectroscopic observations in the infrared region. Spectra were recorded between 2.5 and 15 microns with the incident radiation unpolarized, polarized parallel to an extinction direction of the monoclinic crystal as determined by its behavior toward visible light, and polarized

normal to this direction. The observations were repeated at several temperatures between -178°C . and the melting point of the compound, -35.5°C .

Selection rules appropriate to the crystal have been deduced and an "oriented gas" model has been used to predict the absorption anisotropies. The experimental data are consistent with these predictions. The crystal is composed of the trans molecular isomer exclusively. An assignment of fundamentals previously deduced is shown to be substantially correct and a number of combination tones hitherto unreported have been observed and assigned. Several weakly absorbing bands have been attributed to combinations with lattice modes and within the experimental and theoretical limitations it has been possible to examine the origin of some of these modes.

The spectral observations have been used to discuss the mechanism of a non-first order phase transition which is known to occur at -95°C . The high temperature phase is shown to be characterized by a rotational disordering of rigid molecules in agreement with X-ray diffraction results. The selection rules which determine the spectra corresponding to this phase are consistent with a crystal model postulating short range order within domains accompanied by long range disorder. The life-time of a typical domain is less than one microsecond in accord with proton resonance data. Other models based upon complete static disorder, time-independent local order, and free rotation are shown to require experimental consequences which are untenable with the observations. It is suggested that the deduced model may have additional applications in regard to a large number of substances exhibiting higher order phase transitions which hitherto have been considered examples of either total static disorder or completely free rotation. 126 pages. \$2.00. Mic 57-1972

PART I: VAPOR PHASE DIPOLE MOMENTS OF SOME ALKYL CYANIDES

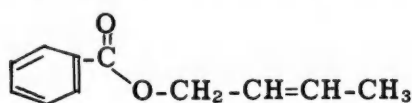
PART II: STUDIES ON THE OXYGEN TO OXYGEN REARRANGEMENTS OF SOME ALLYL ESTERS

(Publication No. 21,206)

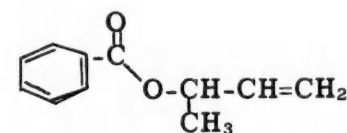
Jorge Heller, Ph.D.
University of Washington, 1957

Part I of this thesis deals with the measurement of vapor phase dipole moments of some alkyl cyanides and a comparison of the values obtained with literature values for other alkyl compounds. An apparatus capable of accurately measuring very small changes in capacity has been constructed. The apparatus has been so designed that the dipole moments of relatively involatile compounds can be measured in the vapor phase at elevated temperatures with no modification of the apparatus or changes in technique. The gas phase dipole moments of acetonitrile, propionitrile, isobutyronitrile, and pivalonitrile were determined. The dipole moments obtained have been compared with those available in the literature and it has been concluded that the rationalization of dipole moments in terms of resonance structures, particularly hyperconjugation, is somewhat arbitrary. All dipole moments examined failed to show any conclusive evidence for hyperconjugation.

Part II describes an investigation directed toward the elucidation of the mechanism of rearrangement of crotyl benzoate (I), to isocrotyl benzoate, (II).



I



II

The nature of the rearrangement was investigated using O^{18} as a tracer. By labeling the carbonyl oxygen of crotyl benzoate and allowing the rearrangement to proceed to equilibrium, a decision as to whether the rearrangement is intermolecular or intramolecular can be reached by analyzing the separated isomers of the rearrangement mixture. Evidence has been obtained which indicates that the rearrangement may proceed via an intramolecular path, both from the mass spectral analysis of the separated isomers and from an independent exchange experiment between labeled benzoic acid and unlabeled crotyl benzoate. Benzoic acid and butadiene are side products of the rearrangement. 165 pages. \$2.20. Mic 57-1973

A THERMOCHEMICAL STUDY OF THE $\text{NH}_3 \cdot n\text{HF} \cdot \text{HF}$ AND $\text{NaF} \cdot n\text{HF} \cdot \text{HF}$ SYSTEMS

(Publication No. 21,184)

Thair Lee Higgins, Ph.D.
University of Michigan, 1955

The purpose of this study is to develop techniques for working with liquid hydrogen fluoride in precise calorimetric investigations and to use these techniques to determine the heat of solution of various hydrofluorinated ammonium and sodium fluorides in liquid hydrogen fluoride. The data are to be used to check the assignment of two residual entropy units to ammonium monohydrogen difluoride, and to calculate heats of formation and decomposition.

The heats of solution are determined in an isothermal 65 ml. calorimeter, which is calibrated electrically. The calorimeter and its contents are stirred by an oscillatory motion which rotates the calorimeter and submarine through 360° in opposite directions at the rate of 22 revolutions per minute.

The values for the molal heat of solution at 298.16°K . of each of the compounds studied at a concentration of 0.044 molal are: $\text{NH}_3 = -42.54$ kcal., $\text{NH}_4\text{F} = 14.31$ kcal., $\text{NH}_4\text{HF}_2 = -5.76$ kcal., $\text{NH}_4\text{H}_2\text{F}_4 = -3.35$ kcal., $\text{NaF} = -15.15$ kcal., $\text{NaHF}_2 = -4.86$ kcal., $\text{NaH}_2\text{F}_3 = -2.16$ kcal., $\text{KHF}_2 = -9.81$ kcal., $\text{NaAc} = -34.0$ kcal., $\text{C}_6(\text{CH}_3)_6 = -0.34$ kcal.

The value for the heat of formation of ideal gaseous hydrogen fluoride is reviewed. The value for the heat of formation of liquid hydrogen fluoride at 298.16°K . is calculated to be -71.8 kcal./mole.

Using the heat of solution data and the heat of formation of liquid hydrogen fluoride, heats of formation of the various fluorides are calculated to be: $\text{NH}_4\text{F} = -111.0$ kcal./mole, $\text{NH}_4\text{HF}_2 = -191.4$ kcal./mole, $\text{NH}_4\text{H}_2\text{F}_4 = -337.4$ kcal./mole, $\text{NaHF}_2 = -218.0$ kcal./mole, $\text{NaH}_2\text{F}_3 = -292.5$ kcal./mole.

The heats of formation are used to calculate heats of decomposition of the compounds and these values are compared with enthalpy increments calculated from the temperature dependence of pressure measurements made by other investigators.

This study shows that precise calorimetric techniques for studies of anhydrous hydrogen fluoride solutions can be developed and that the difficulty of working with the anhydrous material is overcome by the advantage of being able to arrive at an answer with less observations and, hence, greater accuracy than would be required if aqueous hydrogen fluoride were used as the solvent. A partial confirmation of the tentative assignment of about two units of residual entropy to ammonium monohydrogen difluoride is obtained. The review of the data on the heat of formation of gaseous hydrogen fluoride shows a need for heat content data on gaseous hydrogen fluoride.

98 pages. \$2.00. Mic 57-1974

I. THE SECOND VIRIAL COEFFICIENT
OF ARGON AT LOW TEMPERATURES
AND LOW PRESSURES
II. THE HEAT CAPACITY OF LIQUID NITRIC
OXIDE ABOVE ITS NORMAL BOILING POINT

(Publication No. 21,480)

Eugene Charles Kerr, Ph.D.
The Ohio State University, 1957

I. As part of a long-range program to measure the thermal and transport properties of the common gases, the second virial coefficient of argon has been determined over the temperature range, 80°K. to 300°K.

The measurements were made with a 300 cm.³ constant volume gas thermometer whose temperature scale had been calibrated in place against the hydrogen gas thermometer scale. The experimental observations gave the second virial coefficient at each temperature relative to its value at 0°C. Absolute values were obtained by use of the best literature values for the density of argon at 0°C. Final results express the coefficient, B, as a reciprocal power series in the temperature from which the average deviation of the experimental observations is 2.6 cm.³/mole. It is shown that the usual expressions (such as Berthelot's equation) used for calculating gas law deviations at low pressures are adequate unless the derivatives of B with respect to T are required.

II. The results of earlier investigations of the heat capacity of liquid nitric oxide showed that the slope of the heat capacity curve was unusually steep near the normal boiling point and that the calculated entropy of vaporization was abnormally high. This effect has been attributed to dimerization of nitric oxide in the condensed state, the excess specific heat of the liquid arising from depolymerization of the dimer. The purpose of the present investigation was to study the specific heat of liquid nitric oxide above its normal boiling point in order to gain additional information on the thermodynamics of the reaction, 2NO = N₂O₂.

The calorimeter was made of high tensile strength stainless steel, designed for pressures up to 1000 p.s.i. The calorimeter environment and the auxiliary equipment were of conventional design. The directly observed heat

capacity of the filled calorimeter system, when corrected for the specific heat of the empty calorimeter, gave the total heat capacity of the nitric oxide present, liquid plus vapor. Corrections for the heat capacity of the vapor and for the heat of vaporization of the additional liquid which vaporized in the temperature interval of each measurement could not be applied with sufficient accuracy from the meager information available in the literature. Consequently, additional measurements of the vapor pressures and molar volumes of nitric oxide, above the normal boiling point, had to be made. The molar volume was measured as a function of temperature from 119°K. to 172°K. in a one cm.³ Pyrex dilatometer immersed in a specially designed isopentane cryostat. Vapor pressures were measured over the same temperature range by attaching a precision dead-weight pressure gauge to a high-pressure calorimeter.

The final corrected heat capacities of saturated liquid nitric oxide fit a smooth curve to within 0.2 per cent and agree to within this amount with the data of earlier investigations in the low-temperature region where the results overlap. The heat capacity curve is of different shape and much higher than the curves for the few other substances on which data are available for the region above their normal boiling points. The contribution of the observed heat capacity to the entropy has been calculated at 5°K. intervals from the triple point (110°K.) to 160°K. and compared with entropy values derived from the gas spectrum and appropriately corrected. This comparison shows reasonable consistency between the entropies derived from the two sources within the limits of error imposed by the uncertainties in the gaseous P-V-T data which must be used to reduce the two sets of data to a common basis.

80 pages. \$2.00. Mic 57-1975

THE ELECTRODEPOSITION OF
IRON-MOLYBDENUM ALLOYS

(Publication No. 21,192)

Albertine Krohn, Ph.D.
University of Michigan, 1956

Although pure molybdenum can be deposited only from a fused salt bath in the absence of oxygen, a number of alloys of molybdenum can be electrodeposited from aqueous solutions. A higher percentage of molybdenum codeposits with iron than with other alloying metals. This research was undertaken in order to develop an aqueous plating bath suitable for the production of these alloys and to study the effects of variations in concentration and conditions on the composition of the alloy plate and on the efficiency of the deposition process.

A number of preliminary experiments were performed using baths suggested in the literature and various modifications of these baths. These experiments indicated that the best iron-molybdenum alloy deposits were obtained from a solution containing sodium molybdate, ferric chloride, and sodium pyrophosphate, buffered to a pH of 8 with excess sodium bicarbonate. This bath was found to be very stable and gave no undesirable products during electrolysis.

In the course of these preliminary experiments, it was discovered that wiping the cathode during plating greatly

increased the efficiency of the process. This gain in efficiency resulted from removal of hydrogen bubbles which formed on the cathode surface.

A plating cell was designed to provide a method for the variable rotation of a cylindrical cathode between rubber wiper blades. A special calomel electrode was constructed so that the potential of the cathode could be measured during the plating process. A complete study of the effects of the variables was made with the incorporation of the wiping procedure.

These experiments showed that it is possible to electrodeposit from aqueous solutions iron-molybdenum alloys which are bright and adherent in thicknesses up to a few hundredths of a millimeter. The plating solution which gave deposits high in molybdenum content with good efficiency contained: $\text{Na}_2\text{MoO}_4 \cdot 2\text{H}_2\text{O}$ (40 g/l), $\text{FeCl}_3 \cdot 6\text{H}_2\text{O}$ (9 g/l), $\text{Na}_4\text{P}_2\text{O}_7 \cdot 10\text{H}_2\text{O}$ (45 g/l), and NaHCO_3 (75 g/l). The most practical operating conditions were achieved with rotation of the cathode at 1750 r.p.m. between two rubber wiper blades, using a current density of 140 amp/ft^2 (15.6 amp/dm^2) for ten minutes with the system at 50°C . Deposits on a 21.73 cm^2 electrode produced under the above conditions weigh about 0.17 g., contain about 61 percent Mo, 33 percent Fe, and 6 percent O_2 , and are plated with an efficiency of about 44 percent.

The mechanism of molybdenum alloy deposition is not yet known. The complex kinetics of single-metal deposition are further complicated by the fact that molybdenum does not deposit by itself from aqueous solutions. Of the several mechanisms proposed for the electrodeposition of molybdenum alloys, the hydroxide film theory provides reasonable explanations for most of the experimental data. However, no theoretical treatment is yet available to explain all of the phenomena connected with this type of co-deposition. 129 pages. \$2.00. Mic 57-1976

THE STABILITIES OF IONS IN AQUEOUS SOLUTION

(Publication No. 20,140)

Paul Chambers Milner, Ph.D.
Princeton University, 1956

Our basic understanding of the free energies of formation of ions in aqueous solution is limited by the lack of knowledge of the free energies of hydration of the ions and of the proton. This study seeks to improve our understanding by a theoretical treatment of hydration energies. Previous calculations of hydration energies are reviewed and criticized.

Two basic models are used in the present calculations. In one model the ion is assumed to be complexed with four tetrahedrally arranged water molecules and in the other it is assumed to be complexed with six octahedrally arranged water molecules. These complexes are then immersed in the bulk solvent. The hydration energy is calculated as a function of the separation of the ion from the water molecules in the complex. The electrostatic forces between the ion and the permanent and induced dipoles of the complexed water molecules are treated as if the ion were a point charge and the water molecules were point dipoles. The interaction with the remainder of the solvent

is treated by the Born theory. The repulsive energy due to the interpenetration of the charge clouds within the complex is considered in two ways: as an exponential function and as an inverse power of the ion-dipole distance.

The ground states of certain ions are degenerate, and the degeneracy may be removed by the electrostatic field of the complexed water molecules. In these cases there is an additional stabilization, whose magnitude can be calculated by means of first-order perturbation theory. As a by-product of this calculation, the positions of the other levels of the most stable electronic configuration can be estimated. The interpretation of the observed absorption spectra in terms of these levels makes it possible to find numerical values for some of the parameters required for evaluating the hydration energy.

The principal problem is found to be the determination of the constants in the repulsive energy terms. This is attacked in two ways. First, the cation-oxide ion distances in NaCl-type crystals are used as the ion-water dipole separations, but since this method is not sufficiently general, it is not very satisfactory. The second, more generally useful method relates the repulsive constants to the univalent radii of the ions. A set of these radii from the crystalline fluorides is used to calculate the free energies of hydration of various ions known to exist in S_0 states. These calculations indicate that the free energy of hydration of the proton is approximately $-284.0 \text{ kcal./mole}$. From this value and the known free energies of formation of S_0 ions, the univalent radii of ions with closed shells are calculated. The univalent radius is then assumed to be a linear function of the number of electrons in unclosed shells, and in this way a reasonably complete set of univalent radii is obtained for ions with charges between +1 and +3.

These radii are used to compute the free energies of hydration and formation of 44 known ions, and the tetrahedral model is found to be more stable than the octahedral one in most instances. The agreement between observed and calculated free energies of formation is usually good. The method is then used to predict the free energies of hydration and formation of 49 ions for which measurements are not yet available. 153 pages. \$2.05. Mic 57-1977

PHASE EQUILIBRIUM IN SYSTEMS WITH SUPERCRITICAL CARBON DIOXIDE

(Publication No. 20,156)

Robert Audley Snedeker, Ph.D.
Princeton University, 1956

This study was directed to the generalization of the phase behavior of binary and ternary systems in which one of the components is near its critical conditions and the other component or components are relatively non-volatile. It was intended that this work would supplement and extend Todd's studies (12) with ethylene in binary systems and Weinstock's studies (14) with ethylene in ternary systems.

Carbon dioxide was selected as the gaseous component since it is readily available and has critical constants convenient for laboratory work ($T_c = 31.1^\circ\text{C}$, $P_c = 73 \text{ atm.}$).

The mutual solubility of carbon dioxide was determined

with the following liquids at the following temperatures: 35.0°C., acetone, acetonitrile, n-amyl alcohol, aniline, chlorobenzene, n-decane, ethylene glycol, formamide, n-heptane, n-hexadecane, methanol, n-octanol, n-propanol, and toluene; 32.1°C., 2-chloroethanol, furfuryl alcohol, methylaniline, and n-tetradecane; 31.6°C., formamide and n-octanol; 50.0°C., n-decane. The ternary systems included carbon dioxide with the following binaries: at 32.1°C., water-acetone, water-acetic acid and methanol-n-heptane; and at 35.0°C., ethylene glycol-n-propanol and aniline-methanol.

In the binary systems, the mutual solubility of supercritical carbon dioxide with an organic liquid was found to parallel that of liquid carbon dioxide with the same liquid. Binary systems of two immiscible liquid phases in equilibrium with a vapor phase, above the critical temperature of carbon dioxide, were found with 2-chloroethanol, furfuryl alcohol, methylaniline and n-tetradecane at 32.1°C. and with n-octanol at 31.6°C. Criteria for predicting the existence of this two-liquid-phase behavior in other systems are presented. The behavior of supercritical carbon dioxide with organic liquids was found to be similar to that of supercritical ethylene, and the properties of the organic liquids that tend to reduce the mutual miscibility are increased molecular weight, increased polarity, and increased hydrogen bonding.

The ternary data are interpreted on the basis of a vapor region intruding on the corresponding all-liquid diagram. The effects of supercritical carbon dioxide on water-acetone and water-acetic acid were similar to those of ethylene (14). Based on Francis' work (4) with subcritical carbon dioxide, a series of other binaries which may be expected to exhibit phase behavior similar to that of water-acetone or water-acetic acid with carbon dioxide is predicted. The effect of carbon dioxide on methanol-n-heptane was to homogenize the immiscible pair of liquids. Predictions, again based on Francis' work, are made for other immiscible pairs which should be homogenized by carbon dioxide.

Recommendations are presented for further work with polar gases. 131 pages. \$2.00. Mic 57-1978

THE MECHANISM OF COMBUSTION OF AN AMMONIUM PERCHLORATE-POLYESTER RESIN COMPOSITE SOLID PROPELLANT

(Publication No. 21,161)

George Sharp Sutherland, Ph.D.
Princeton University, 1956

For abstract, see page 1280.

252 pages. \$3.25. Mic 57-1979

THE ACTIVITY COEFFICIENT OF LiCl IN DILUTE AQUEOUS SOLUTION AT 25°C.

(Publication No. 21,018)

Peter Trueman Thompson, Ph.D.
University of Pittsburgh, 1957

The potentials of concentration cells with transference were measured at 25°C. and used to calculate the mean ionic activity coefficient of LiCl in dilute aqueous solution. The work was undertaken with two objectives. The first was to obtain new reliable data, since published values of $\log \gamma$ for this salt, based on freezing-point measurements of Scatchard and Prentiss and upon isopiestic-vapor-pressure comparisons of Robinson and Sinclair, do not agree well with each other. The second purpose was to investigate the high-dilution anomaly found from freezing-point measurements in the $\log \gamma$ -vs.- $m^{1/2}$ curve of this salt.

When the freezing-point data, expressed as values of $j/m^{1/2}$, are plotted against $m^{1/2}$, a "hump" in the curve is observed below 0.01 molal. This is equivalent to $\log \gamma$ crossing the Limiting Law of the Debye-Hückel theory and reapproaching from the underside with a slope greatly exceeding the theoretical slope. Since freezing-point data are known to exhibit scattering at high dilution, Scatchard and Prentiss took only partial account of this anomaly in their calculations. $\log \gamma$ at 25°C. was recalculated in this work with the full "hump" being treated as physically real.

The emf measurements were performed using techniques which are now standard. The totally electrolytic Ag; AgCl electrodes were similar to those described by workers of the Toronto School. The cell, thermostat, and electrical system were of more or less conventional design. The LiCl was carefully prepared and purified and all solutions were made up by weight-diluting a concentrated analyzed stock solution.

Fifty-eight experiments were performed on 20 different solutions. Of these, 52 involved direct comparison of various solutions ranging in concentration from 0.0007 to 0.2 molal against a fixed reference solution (0.047 molal). Six so-called "short-chord" cells involving concentrations of 0.0007 molal against 0.001 to 0.003 molal were measured to study the possible error introduced by the residual conductance of the solvent. Water of high, low, and medium specific conductance was used as solvent for these cells in order to exaggerate or suppress the possible effect.

Values of $\Delta \log \gamma$ (the change in $\log \gamma$ between various molalities and the reference molality) were calculated with the aid of standard equations and techniques. The transference-number data for Li^+ were the moving-boundary values of Longworth. The $\Delta \log \gamma$ results show a steep turn up below 0.002 molal with a slope large enough to eliminate any immediate hope of independently extrapolating the data to infinite dilution. In particular, the "short-chord" values exhibit this turn-up with no striking difference (if any) being observed among the cells involving water of different specific conductance.

The $\Delta \log \gamma$ data were converted to absolute values of $\log \gamma$ by adding a constant quantity which produced equality with the recalculated freezing-point values at 0.1 molal. When plotted against $m^{1/2}$ these emf and the recalculated freezing-point values are in good agreement over the entire experimental range of molalities and coincide from below 0.01 molal to above 0.16 molal. Both curves exhibit

the same sharp turn-up in $\log \gamma$ below 0.002 molal. At high dilutions the two sets differ somewhat and in view of the uncertainties in drawing the $j/m^{1/2}$ curve in the region of the "hump," the emf results are perhaps the more reliable. The latter are therefore listed as recommended values.

The published vapor-pressure values of Robinson and Sinclair differ from the new recommended values by a fairly constant amount in \log . Such a difference must occur because the former were extrapolated to infinite dilution without taking account of the above observed anomaly. Acceptance of the new values results in the uniform lowering of their published vapor-pressure $\log \gamma$'s by 0.0113.

79 pages. \$2.00. Mic 57-1980

VIBRATIONAL SPECTRA AND MOLECULAR STRUCTURE OF SOME HALOGENATED METHYL CYANIDES

(Publication No. 21,403)

Samuel C. Wait, Jr., Ph.D.
Rensselaer Polytechnic Institute, 1957

Supervisor: Dr. George J. Janz

The series of halogenated methyl cyanides: CF_3CN , CF_2ClCN , CCl_2FCN , and CCl_3CN , presents the interesting case where the substituent, X, in the CX_3 group is progressively replaced by an atom of lesser electronegativity. To observe the effects of these substitutions, the vibrational spectra of these compounds have been investigated using infrared absorption and Raman scattering techniques. The fundamentals, combinations and overtones have been assigned from the data obtained. Comparison of these assignments shows regularities in certain fundamentals, e.g., the $\text{C}\equiv\text{N}$ stretch, the C-F symmetric and antisymmetric stretches, C-C $\equiv\text{N}$ symmetric and antisymmetric bendings, which can be attributed to changes in the force field caused by the decreasing electronegativity of the CX_3 group.

A normal coordinate vibrational analysis has been carried out for trichloroacetonitrile for the purpose of investigating the intramolecular force constants acting in this molecule. The most general quadratic potential function was used to establish the values of the force constants. There are not enough observed frequencies, however, to permit the calculation of a unique set of these force constants. Comparison of the force constants used for CCl_3CN with other molecules having the CCl_3 group shows that a simple transfer of constants from one system to another is possible only as a first approximation. The values of the force constants must be determined by a series of calculations using "best" values in the normal coordinate analysis.

The statistical thermodynamic functions have been calculated to the rigid rotator, harmonic oscillator approximation for the ideal gas state at one atmosphere pressure. Values of the heat capacity, heat content function, free energy function, and entropy are given for these molecules at 9 temperatures from 298.16°K. to 1500°K.

139 pages. \$2.00. Mic 57-1981

SYNTHESIS AND TRANSPORT SPECIFICITY OF SOME ION-SELECTIVE INTERPOLYMER MEMBRANES

(Publication No. 21,421)

David Major Wetstone, Ph.D.
Polytechnic Institute of Brooklyn, 1957

Ion-selective, interpolymer membranes were cast from N,N-dimethylformamide solutions of a copolymer of vinyl chloride and acrylonitrile with either polystyrenesulfonic acid (PSA), a copolymer of vinylmethyl ether and maleic anhydride (PVM-MA), or a polymer of 1-vinyl-3-methylimidazolium iodide (QPVI). In this technique the matrix polymer intermeshes with and insolubilizes the polyelectrolyte, while permitting the dissociable groups of the latter (the active sites) to concentrate in hydrophilic passages through which ambient species may pass.

Characterization studies were performed, including thickness, burst strength, water content, exchange capacity, osmotic flow rate, electrical resistance, concentration potentials in potassium chloride, and bi-ionic potentials of calcium or lithium chloride (for PSA and PVM-MA films) or potassium iodate (for QPVI films) against potassium chloride.

A variable stirring speed bi-ionic potential cell was designed. Flow rates up to 450 cm./sec. across the membrane faces did not produce maximum potentials, thus emphasizing the large uncertainty in published data due to unstirred films. At lower rates, the decay (reduction in potential) progressively increased.

Cation specificity (transport preference between cations) was examined for calcium-potassium and copper(II)-potassium systems through comparison of data on selectivity coefficients and specific conductance as a function of membrane cation distribution, bi-ionic potentials, and ionic transport measurements. Both membrane species evidenced preferential uptake of calcium over potassium, beyond that thermodynamically expected. Copper(II) preference was one to two orders of magnitude greater than calcium for the PVM-MA films. Calcium-potassium conductance appeared to vary linearly with membrane cation distribution, suggesting that the specificity did not inhibit mobility; the copper-potassium system evidenced anomalous conductances, however.

Some calcium-potassium bi-ionic potentials at high flow rates were above 20 mv., implying a ratio of $t_{\text{Ca}}/t_{\text{K}} = 12$ or more, provided a Henderson liquid junction is assumed. Decay toward negative potentials at lower flow rates suggests that calcium ion was effecting transport predominantly. However, direct transport measurements evidenced a calcium transport advantage no greater than 4, although the high current densities employed may have interfered.

Copper(II)-potassium bi-ionic potentials approximated -14 mv. at high flow rates, increasing rapidly toward positive potentials at lower speeds. Here no divalent ion transport advantage was shown, the copper mobility having been quite low, and it appears that copper was effectively discharging the membrane, permitting free access to potassium, as deduced from the high, positive decay. In addition, the slope of the decay curves depended on anion identity, implying a high anion leak for copper(II) membranes.

This latter conclusion was substantiated by comparative

resistance and concentration potential studies in 0.02 N solutions of calcium chloride as compared to various copper(II) salts. Conventional resistances and roughly theoretical concentration potentials were obtained for both films in calcium chloride, and for PSA samples in copper(II) perchlorate, chloride, and nitrate. PVM-MA samples evidenced 20-fold increases of resistance with the copper salts, and their potentials approximated free diffusion. In addition, the results were markedly anion sensitive, implying differential inhibition of anion mobility, also. This may have resulted from a succinato-type 4-fold coordination of the copper with a pair of anions. PSA films in copper(II) acetate evidenced resistance increases of 3,000-fold, probably resulting from slow acetate hydrolysis and copper(II) precipitation.

Results are described for a number of other interpolymer membrane systems which resulted in films of low electrochemical activity.

164 pages. \$2.15. Mic 57-1982

MOLECULAR KINETIC STUDIES OF POTASSIUM POLYMETAPHOSPHATE

(Publication No. 21,503)

David Franklin Wright, Ph.D.
The Ohio State University, 1957

Potassium polymetaphosphate (PMP) is of interest as an inorganic polyelectrolyte since it can be prepared to a very high degree of polymerization, yielding solutions of unusual properties.

A high molecular weight sample of non-cross-linked PMP, prepared by the method of Pfanstiel and Iler [J. Am. Chem. Soc., **74**, 6059 (1952)], was studied by means of angular light scattering, sedimentation, viscosity, and electrophoresis in solutions of 0.1 M to 0.4 M NaCl.

The results of electrophoresis and sedimentation measurements show that the ionization of PMP decreases with increasing concentration of NaCl, from a value of 1.2 per cent in 0.1 M NaCl to 0.4 per cent in 0.4 M NaCl.

Angular light-scattering studies have shown the weight-average molecular weight to decrease from 5.56×10^6 in 0.1 M NaCl, to 2.27×10^6 in 0.4 M NaCl. At all NaCl concentrations investigated, the polymer was found to fit the model of a polydisperse random coil with a $z = 1$ distribution, for which $M_Z : M_W : M_N :: 3 : 2 : 1$. The

root-mean-square distance between chain ends, $(\bar{r}^2)^{1/2}$, decreased linearly with decreasing $M^{1/2}$. The solute-solvent interaction coefficient, B , decreased with increasing NaCl concentration.

Viscosity measurements of PMP solutions have shown the intrinsic viscosity to be decreased markedly by increasing NaCl concentration. Plots of reduced viscosity, η_{sp}/c , versus polymer concentration were found to be linear in all the cases investigated. This behavior is characteristic of uncharged polymers.

The sedimentation coefficients, extrapolated to zero polymer concentration, increased without apparent limit as the concentration of NaCl was increased. Sedimentation studies also revealed a strong dependency of sedimentation coefficients upon PMP concentration. When corrected for the solution viscosities, they became practically independent of PMP concentration.

These results indicate that PMP yields very highly solvated particles in solution. As the concentration of NaCl increases, it seems likely that a dehydration takes place, causing the root-mean-square distance between chain ends and the polymer-solvent interaction to decrease. If a constant molecular weight of 2.11×10^6 is used in the calculation of the frictional coefficients, agreement with a theoretical equation which predicts that the frictional coefficient is directly proportional to the root-mean-square end-to-end distance for random coils is obtained for all concentrations of NaCl investigated. This would indicate that the molecular weights, as obtained from light scattering, are abnormally high.

If it is assumed that the polymer-bound solvent is sufficiently polarized to exhibit a refractivity different from that of the free solvent, then it is possible for the molecular weights observed by light scattering to be "hydrated" molecular weights which decrease with dehydration caused by the higher concentrations of NaCl.

However, the PMP-NaCl system of this investigation is a ternary system, and it may well be that a partitioning of the solvent (i.e., NaCl + H₂O) takes place about the PMP chains. Such a preference of the PMP molecules for one component of the solvent over the other would affect the molecular weights, but not the dimensions, as measured by light scattering. It is suggested that, as the concentration of NaCl increases, any partitioning of the solvent is lessened.

In any case, the molecular weight appears to approach a constant limiting value of 2.11×10^6 at infinite concentration of NaCl.

164 pages. \$2.15. Mic 57-1983

ECONOMICS

ECONOMICS, GENERAL

SOME ASPECTS OF THE INCOME SIZE DISTRIBUTION: A STATISTICAL STUDY

(Publication No. 21,140)

Francis Gerard Adams, Ph.D.
University of Michigan, 1956

This statistical study of the income distribution is directed toward gaining a better understanding of the factors which determine the size of individual income. The analysis is concerned with two principal questions:

1. Do the heterogeneous socio-economic characteristics of income recipients play a role in the determination of income size?

2. Is the nature of the residual variation of income (after a prediction on the basis of socio-economic variables) related to the underlying processes of random change?

The statistical work was restricted to the wage and salary income of a selected group of white males. The data on which the work is based are from the 1950 to 1953 Surveys of Consumer Finances of the Survey Research Center of the University of Michigan.

With regard to the first question, variance analysis and multiple regression were employed to explain the relationships between size of income and certain socio-economic characteristics of its recipients. On the basis of conservative techniques which were adapted to meet the various statistical problems of this research, it was found that a number of factors--age, education, occupation, community size, region, and fraction of year worked--exert a statistically significant influence on wage and salary income. Combined into a multiple regression equation to predict income, these variables accounted for a substantial fraction of inequality.

The analysis of the residuals was concerned primarily with the relationship between random and residual variation. No attempt was made to identify all possible factors to which residual variation could be attributed. The work showed that the distributions of unexplained residuals differ among occupation categories and that there appear to be corresponding differences in the nature of the underlying random change. Data on the year-to-year variation in the income of identical recipients were introduced into a simple model of the process of random variation and the distributions of the hypothetical random component of income were generated. There was a broad but systematic resemblance between these curves and the distributions of residuals, although statistically significant deviations remain.

These findings have implications with regard to the theory of the income size distribution. The fact that certain socio-economic variables are significantly correlated with size of income suggests that a meaningful approach to the size distribution must recognize the socio-economic

heterogeneity of income recipients. In effect, the results of this study give empirical support to the hypothesis that incomes are not equal because they represent payments for differentiated productive services.

Secondly, the differences, among occupations, in residual variation and in the characteristics of the random processes suggest that certain socio-economic factors--in particular, occupation--have a discernible impact not only on the level of income but on the nature of its random variation as well. 179 pages. \$2.35. Mic 57-1984

GROWTH IN AGRICULTURAL OUTPUT OF SYRIA AND LEBANON: 1926-54

(Publication No. 21,216)

Bashir Jamil Daouk, Ph.D.
The University of Wisconsin, 1957

Supervisor: Professor Kenneth H. Parsons

This study attempts an appraisal of the contribution of agriculture to the economies of Syria and Lebanon through estimate of growth and composition of agricultural output and shifts in location of production over three decades. Net value-added to production is taken as the measure of growth, with net value defined as the difference between gross value-added and material costs.

The agrarian structure of Syria and Lebanon is such as to necessitate a broader definition of the agricultural sector than is usually used. By using wholesale prices in the main towns to value output, what we get is the output arising in the agricultural sector and that part of the service sector catering to agricultural marketing up to the wholesale stage.

The movements of output in current prices reflects the ebb and flow of business activity, especially through the influence of international trade. Five periods can be distinguished: Post war I recovery 1926-29, the great depression 1930-36, recovery of 1937-38, world war II 1943-45, and post-war II 1946-54. Taking 1926-29 as base, the index of net value-added by agriculture became 54%, 133%, 810% and 885% of the subsequent periods. Except in the thirties (when it was 2/3), farm crops net output represented 75% of total output of agriculture. Compared to 1926-29, animal products net output fell less than farm crops during the depression, and except during the war its rate of growth in current prices was higher subsequently. In the post-war period net output of fruits, meat and live-animals and especially industrial raw materials were well above the war level, while wheat, barley, chick-peas, onions, olives, vine and eggs were notably below it.

Year to year fluctuations in gross output is very wide. In about 25% of the years considered year to year rise or fall in output of all farm crops was more than 20%. And

the component groups fluctuated much more widely, especially the two groups of raw materials. The direction of change in farm crops and animal products output was such as to reduce the overall fluctuation in the aggregate.

Through development of irrigation and transport, the acreage under all farm crops more than doubled between 1934 and 1954. No spectacular changes in the choice of products is apparent except for cotton. But an increase in the relative importance of wheat, sorgho, rice, chick-peas, apples and figs is apparent, while the reverse is true in the case of maize, lentils, olives and vines. With the advance toward market orientation of agricultural production, some shifts occurred in the location of production in the three main agricultural regions. The share of the three regions in net output of farm crops did not vary much over the period studied, but the share of different groups of farm crops in net output in each region fluctuated widely.

On the whole the noted broad movements in agricultural output in the different periods is a result of price changes, while in year to year fluctuations yield uncertainties play a major role. In recent years a tendency for slackening in price-index of cereals and pulses is apparent, in contrast to other groups of farm crops.

In years when comparison is possible, the output of farm crops in real terms has been growing much faster than that of animal products. The rate of growth of industrial raw materials and fruits was highest among farm crops. Comparing 1930-34 and 1951-54 real output of farm crops per capita of "agricultural" population registered a total increase of 45%. But comparing 1930-38 and 1947-54, real output per hectare of cultivated land was stable.

The response of wheat growers to price changes seems to be remarkable in view of the rigid structure of the farming system. The extent of subsistence production also appear to have been reduced significantly over the period considered. 301 pages. \$3.90. Mic 57-1985

FACTORS INFLUENCING THE DEMAND FOR NEW AUTOMOBILES: A CROSS-SECTION ANALYSIS

(Publication No. 21,171)

Peter Engel de Janosi, Ph.D.
University of Michigan, 1956

Recent literature in the field of economics has placed much emphasis on the importance of consumers in the present-day economy. In particular, the necessity of analyzing and predicting purchases of large durable goods--houses, household goods and cars--has frequently been stressed, for expenditures of this type play a crucial role in determining the level of economic activity in the country.

The research presented in this dissertation is limited to the area of the demand for new automobiles. The work centers around two groups of consumers: those who have bought a new car during a specified period of time, and those who have not. The purpose is to uncover and examine factors which distinguish between the two consumer groups prior to their purchases of a new car.

The data were derived from the 1952 and 1953 Surveys of Consumer Finances conducted by the Survey Research Center for the Federal Reserve Board. These survey data are based on personal interviews with a sample of families.

They enable the investigator to associate characteristics of the interviewed families with their decisions to purchase a new car, and are, therefore, well suited for the research design of this dissertation. A multivariate analysis was carried out. Linear multiple correlation was chosen as a technique which allowed to test the statistical significance of the relationships between explanatory variables and the dependent variable--new car purchases. The following major findings were obtained:

1. The most important single factor characterizing consumers much before they buy a new car is their expressed intention to do so.
2. Whether families perceive their financial position as improved compared to a year ago is positively related to their decision to purchase a new car.
3. Families owning a new car are more likely to buy a new car than those owning a used car of recent vintage. Least likely to be purchasers of a new car are families owning an "old" used car and those who do not own a car.
4. The size of the families' income for the year preceding the time the new car is bought is found to be unrelated to whether families buy a new car.
5. Demographic characteristics of the families--their age and marital status--play a neutral role with respect to new car purchases. 130 pages. \$2.00. Mic 57-1986

EMPIRICAL ESTIMATES OF SOME REGIONAL AND INTER-REGIONAL INPUT-OUTPUT MATRICES

(Publication No. 21,175)

Bruce Eugene Edwards, Ph.D.
University of Michigan, 1956

This study is an attempt to measure the coefficients in an inter-regional input-output model. In input-output models the economy is divided into a number of sectors. In order to produce goods or services (outputs) a sector must use other goods or services (inputs) which it buys from other sectors. Thus the quantity of output of each sector is determined by the amounts demanded by the other sectors. This results in a single, large interdependent system.

Until recently the sectors in input-output models were differentiated solely on the basis of the product or service produced, ignoring the locational dimension completely. In many policy decisions it is desirable to know both the industries and the regions which will be affected by the possible alternative courses of action and an inter-regional model would be useful.

In this study a general input-output model is first developed along lines suggested in an article by Walter Isard. Various input-output models are then discussed as special cases of the generalized model based on explicit assumptions.

The original models developed for this paper fall into two broad types, both based on data from the Interstate Commerce Commission's one per cent sample of carload freight movements. The first group includes several gross inter-regional models without commodity differentiation analogous in form to the inter-industry models without regional differentiation. Conventional input-output techniques are used for these models.

The second group of models are estimated from time

series and involve both regional and commodity differentiation. The technique of instrumental variables rather than of least-squares-regression was used in making these estimates. In making these estimates two serious problems arose. The first was the development of negative estimates of the coefficients. This would mean that as a sector produced more of a given product it would need less total material to produce it with. This is usually unrealistic on a priori grounds.

The second problem was failure to get significant correlations between estimated and actual demands. These two problems did not appear to be related. Because of these problems, large parts of this model were not successfully estimated.

Throughout the paper, and in the last chapter, the reliability of the various models was compared on the basis of two tests commonly used; (1) error of estimate as a percentage of actual values and (2) a comparison with estimates based on proportionate expansion of the economy. Using these tests many of the original models developed in this paper did as well or better than models previously developed by others.

Two general conclusions are reached. The first is that the technique of instrumental variables probably is more useful in refining estimates to remove least-squares biases than for making original estimates. The second conclusion is that the tests of input-output models currently in use are rather weak. This latter conclusion is reached because there are many a priori economic objections to some of the models which gave errors comparable to those in other input-output studies.

Two related matters of some interest are treated in the appendices. The first is a brief description of the program used for making some of the computations on an electronic computer. The second is a technique developed for simultaneously eliminating several equations and unknowns from a system of simultaneous linear equations.

193 pages. \$2.55. Mic 57-1987

INDUSTRIAL DEVELOPMENT OF INDIA: HUMAN RESOURCES AND THEIR UTILIZATION

(Publication No. 21,231)

Harcharan Lal Upadhyaya, Ph.D.
The University of Wisconsin, 1957

Supervisor: Professor Selig Perlman

As the title of the study, Industrial Development of India: Human Resources and Their Utilization, indicates, its central objective aims at the ways and means to develop a labor force for long-run efficiency. The main emphasis throughout the dissertation is placed, in conformity with the ideological principles adopted by the young Indian nation to shape its social and economic future, upon the development of human resources.

The scope of the study can be identified by listing here some of its important characteristics: (1) The study has the function of tying in one "package" the primary problems in a number of different areas--education, health, skilled labor, industry. (2) The essential relationships among vast areas of the Indian problems have been brought

into one discussion and analysis. (3) Substantial and well-documented data on some of the more important and basic problems, necessary to a general understanding of the Indian problem, constitute the special feature of the study. (4) The study is intended for a wide variety of readers in the hope that it may have the effect of stimulating fresh thinking and, possibly, action coming under the headings of the initial steps that need to be taken in a developing economy. Government administrators in charge of health, education, community development, labor and industry, educational leaders, legislators, industry management personnel, students and general readers may find the study of some interest.

Altogether, there are five unified chapters covering 300 pages and about 50 pages of appendices. The factual information contained in these pages is dated 1951 to 1956.

The study is divided into two parts. Part I, "Basic Background" has three chapters containing reconstructed analyzed data on Indian economic life. These chapters deal with "Resources" (both physical and human), "Economic Structure: Recent Developments" (in both agrarian and industrial structure), and "Barriers to Industrial Development" (both the basic and "operational" factors). Part II consists of two chapters devoted to educational programs for the development and utilization of human resources in India.

Practical and positive solutions to some of the larger and important problems of manpower utilization--namely, the problem of unemployment, the lack of suitable technical and managerial "skills," the low state of popular health, and the working environment as a whole--have been suggested. These solutions (although necessarily partial), with procedural details, include: vocational guidance and training, an efficient public employment service, community self-help, industrial health, school health and education for management.

The material used in preparing these chapters is taken from Indian government publications, United Nations publications, published books in related areas and extensive correspondence with professional people serving labor, industry and schools in the United States. An important amount of information bearing on matters of policy and the best practice in the above-mentioned areas has been obtained in personal interviews and long-continued associations with the administrative heads of the governmental agencies in the State of Wisconsin.

363 pages. \$4.65. Mic 57-1988

THE IMPACT OF THREE BUSINESS RECESSIONS IN THE UNITED STATES ON THE REST OF THE WORLD

(Publication No. 21,367)

Edwin von Böventer, Ph.D.
University of Michigan, 1956

The aim of this dissertation is to establish in quantitative terms the impact of a business recession in the United States on the outside world, to establish typical quantitative relationships for United States trade which can be expected to hold for a future mild recession in the United States. For this purpose, the experiences during

the 1937-38, the 1949, and the 1953-54 recessions were studied.

The paper contains a detailed analysis of the changes which took place in the United States balance of payments during these three periods. The emphasis lies on the changes and determinants of commodity trade. Multiple regression equations are set up for both United States imports and exports. Total commodity trade is broken up into five trade categories which have determinants of their own: crude materials, semimanufactures, finished goods, crude foodstuffs, and manufactured foodstuffs.

Results: For the United States import categories, satisfactory equations were obtained for all three recessions. For special reasons, no meaningful monthly food import equations could be established for the 1937-38 recession. On the basis of the relationships established for the commodity groups, a general short-run function for the changes in total import values is derived with United States manufacturing production, manufacturers' sales, personal income, and raw material import prices as the only exogenous variables. In the case of United States exports, the behavior of the non-food categories could be explained in all three recessions, but neither the parameters nor even the explanatory variables were always the same from recession to recession. The variables used were foreign industrial production weighted by the economic distance from the United States, an index representing supply and demand of raw materials at home and abroad, the accelerator, relative prices, and the supply of dollars in foreign countries. It was not possible to set up a predictive export equation for a future recession since, on the one hand, as mentioned above, the explanatory variables in the non-food export equations were not the same in all recessions and since, on the other hand, no monthly or quarterly food export equations could be established.

It is shown that, apart from the changes in United States food supplies in the prewar period, it was the specific situation abroad rather than the nature of the downturns in the United States which was responsible for the great difference in the international repercussions of each of the three recessions. 249 pages. \$3.25. Mic 57-1989

FORECASTING INVENTORY CHANGES IN THE PRIVATE SECTOR OF THE AMERICAN ECONOMY

(Publication No. 21,132)

Norbert Daniel Warren, Ph.D.
Columbia University, 1957

The dissertation formulates a new model of aggregate inventory behavior in manufacturing and trade based on a reappraisal of the relevant quantitative and qualitative evidence of the pre-war and post-war years. This evidence indicates that aggregate inventory movements result mainly from the interaction of five factors: Business sales; sales expectations; the sales elasticity of inventory demand; the capacity of the economy versus final demand; and the differences between certain major categories of stocks.

Sales and the sales elasticity of inventory demand -- not simple inventory-sales ratios -- define the equilibrium or normal value of inventories at any time. The sales

elasticity of inventory demand is found to be less than unity and stable, during upswings and downswings in sales, but to have different values for these two phases.

Actual inventories often diverge from normal in the short run for three reasons:

i) Errors in the expectations which determine production and inventory plans. However, recent analysis has shown such errors to be less large than is commonly supposed, and capable of rapid correction. Expectations, as a rule, underestimate degrees of change moderately, but anticipate cyclical turning points in the aggregate, implying that unforeseen inventory changes are overrated.

ii) During cyclical expansion periods, inventories may diverge from normal because of the physical inability to produce enough for both final and inventory demand. A willingness to hold less than normal inventories in order not to lose sales is implied.

iii) The great variety of inventories held in the economy leads to an equal number of technical and managerial problems. It is these which most often determine the degree of deviation, if any, from normal. Following the lead of Abramovitz, the various stocks can be grouped into three basic inventory categories, here differentiated by whether they regularly lead, coincide, or lag at cyclical turning points. These categories are closely correlated with the degree to which businessmen can accept or even plan for a temporary divergence of stocks from "normal".

Such voluntary divergence is the rule, rather than the exception. Hence, most conclusions and prognoses are faulty, which are based on the concept that businessmen desire a stable inventory-sales ratio in the short run, and particularly during cycles.

Inventories are found to be normal, in the special sense previously defined, at cyclical peaks and troughs. Yet they become a cause of cyclical turning points, since their rate of growth towards the end of a cyclical upswing cannot be sustained. Until late in expansion, the amounts available for stocks after satisfying final demand are too small to bring inventory levels to normal. This is due to underestimates of actual sales and, more important, to physical capacity limits on the volume of total output.

Thus an inventory deficit develops. But this is made up once final demand slows down its growth sufficiently to permit more inventory accumulation. When the normal level of stocks is reached, as defined by the sales elasticity of inventory demand and the prevalent level of sales, inventory investment drops sharply and tends to bring on a turning point in economic activity. The slow-down of sales is by implication an important contributor to the "causal" mechanism of inventories in cycles. It is also implied that the rate of inventory accumulation will tend to reflect both the absolute level of sales and the rate of change in sales.

During contractions, the rate of inventory reduction is for many reasons usually less than that required to bring stocks immediately to normal. However, as the rate of decline of final sales diminishes, inventories can be more conveniently brought into line. Once a normal level is achieved, disinvestment stops and this helps to turn the cycle at the trough.

Since business sales expectations are an important factor in inventory movements, and since they are good predictors of cyclical peaks and troughs, they also serve as a good predictor of aggregate inventory investment turning points. Moreover, since the normal level of stocks

can at any time be defined by using current sales and the empirically established sales elasticity of inventory demand, then given the current level of stocks, a good judgment can be made whether accumulation or disaccumulation will continue. Leads and lags of various inventory types also furnish interesting indicators of aggregate inventory behavior.

Given a short run estimate of future final demand, it is also possible to work out a logical value for future inventory demand, thus predicting inventory behavior and its wider repercussions.

As a corollary of this investigation, it is shown that changes in private farm stocks are of no significance for cyclical forecasting under the conditions prevalent in the U. S. agricultural economy at this time.

214 pages. \$2.80. Mic 57-1990

ECONOMICS, COMMERCE - BUSINESS

AN APPLICATION OF GENERALLY ACCEPTED PRINCIPLES OF GOVERNMENTAL ACCOUNTING AND AUDITING TO THE COUNTIES OF GEORGIA

(Publication No. 21,147)

Homer Augustus Black, Ph.D.
University of Michigan, 1956

The purpose of this study is to demonstrate the weaknesses of present-day accounting and auditing for county governments of Georgia, and to suggest practical means for applying the best in modern accounting and auditing to these counties. Reliable, current financial information is needed by county officials in managing county affairs; by state officials and legislators in supervising counties and in distributing equitably to them a lion's share of state-collected revenues; by present and potential creditors; by students of government; and by citizens.

Accounting is defined to encompass budgeting and reporting, as well as auditing. Literature dealing with these related areas is surveyed in order to determine the generally accepted principles of governmental accounting and auditing. The standard principles and procedures enunciated by the National Committee on Governmental Accounting, the primary authority in the field, together with a brief exposition of their rationale, are presented as a norm against which to judge existing conditions in Georgia. Practice in a few other states thought to have made greatest advances in county accounting is summarized. Legal restrictions governing Georgia county accounting are examined. Five case studies of representative Georgia counties, selected largely on the basis of population, are analyzed to determine the status of practice and operating requirements. These are supplemented by an examination of audit reports of additional counties and the report of an exhaustive WPA fiscal survey completed in 1938.

Although a few isolated examples of acceptable accounting may be found among Georgia counties, the conclusion is inescapable that practice in most of them is chaotic. The governing legal structure is an irrational, archaic patchwork. Worse still, there is no provision for nor effort

at enforcement. Central financial reporting is non-existent. In theory the state legislature regulates the counties by passing acts of local application, but it has abdicated the supervisory function. There are no budgeting laws, and laws dealing with auditing are vague and ineffectual.

The basic aim of the study is to suggest means for correcting this situation. The main parts of the presentation are: county organization, budgeting, the accounting system proper, reporting and auditing. Under each are described generally accepted principles, current legal requirements, current practice, recommendations for improvement in the law, and recommendations for improvement under existing law. Because of past legislative inertia or even active opposition to change, the latter recommendations are the only detailed ones. Broad new laws are advocated, providing a supervisory body with power to prescribe general principles of county budgeting, accounting, reporting and auditing.

The recommendations for improvement in practice are addressed to professional accountants: the independent auditor or systems man as well as the county accountant. The accrual basis of recording expenditures is recommended for all counties; while the cash basis of reflecting revenues, with memorandum accounts for assets, is favored. Comparability of account classifications is essential, although absolute uniformity is both unworkable and undesirable. The recommended classification of expenditures by major activities and receipts by major sources is uniform throughout the state, but it accommodates great differences in county needs by expansion or contraction of the primary categories.

Other technical details consist of suggested general procedures for recording the budget, levying taxes, making collections, placing orders, making expenditures, and accounting for long-term assets and liabilities. The summary accounting effect of typical transactions is illustrated, together with forms of suggested statements. A check list from which an audit program may be developed is furnished in an appendix.

The recommendations of the study, although reasonably specific, must still be tailored to fit local requirements. Most importantly, the legal and administrative requirements for accounting must be kept broad and flexible enough to permit adoption of improvements in the art of accounting.

467 pages. \$5.95. Mic 57-1991

CONCEPTS AND MEASUREMENTS OF BUSINESS INCOME: ECONOMICS AND ACCOUNTING

(Publication No. 21,162)

Tsun Chen, Ph.D.
University of Michigan, 1956

What is "business income"? How should it be measured? These problems have been constantly discussed by both accountants and economists, yet no close agreement has ever been reached. This is not so much because the two are inherently irreconcilable. Rather, the two groups have never tried to understand each other. The present study is intended to provide a bridge between the two points of view, as mutual understanding will benefit the future development of both fields.

In this study, accounting concepts and measurement of business income are first presented in general terms; and then, economic concepts and measurement of business income are similarly formulated. From this analysis, we find that in accounting business income was originally viewed as the increase in net worth of proprietors and measured mainly through the balance sheet; but now, it is generally conceived as the residual from matching revenue and expenses, measured mainly through the income statement. It is a money concept, calculated periodically for a specific firm. "Objectivity" and "accuracy" are specifically emphasized. Most conventions and doctrines are introduced to meet this standard. The resulting income is thus made very definite and certain.

In economics, business income, from the mercantilists through Alfred Marshall, was usually conceived as the difference between gross revenue and expenses needed to maintain fixed and circulating capital intact. This was basically an income statement point of view, adequate for a static situation. But now, most economists agree with Hicks that business income should be viewed more broadly as the maximum amount which a firm can distribute as dividends and still be as well off at the end of the period as at the beginning. Emphasis is thus shifted to the valuation of the balance sheet; moreover, the role of "expectation" takes on crucial importance. The resulting income cannot be "objective" and "definite" but must be "subjective" and "tentative."

From this separate analysis, we find that there are, at least, three basic issues which differentiate the one concept from the other.

1. There is the problem, brought about particularly by changes in business prospects, of accretion versus realization as the criterion for income recognition. In seeking "objectivity" and "certainty" accountants follow religiously the rule of realization evidenced by a sale. In emphasizing "relevancy" and "logic" economists argue constantly for the criterion of accretion, ascertained through periodic revaluation, and think that effective sale is not necessary for income recognition.

2. There is the problem of inclusion versus exclusion of unexpected gain. Such a problem arises from changes in expectations. We find that this issue is mainly one of income *ex ante* versus income *ex post*. If the former is used, there will be no unexpected gain. If the latter is applied, unexpected gain will naturally appear.

3. As a result of changes in the value of money, there is the problem of money income versus real income. In an economy where the price level remains stable, accounting income expressed in money terms will agree with economic income expressed in real terms. In an economy where the price level rises or falls, both will diverge theoretically and practically.

Finally, the various income concepts developed in this study are tested briefly against some practical problems of income measurement as seen by owners of capital, management, students of taxation, and students of national income. We find that the choice of income concept must depend upon the use to which it is put. There is no ideal concept which can satisfy all circumstances. In the middle of conflicting interests, the role of the accountant is to adopt multiple income concepts and prepare various financial statements for various interests with, however, the present accounting system as a starting point. Herein lies the challenge to the accounting profession.

271 pages. \$3.50. Mic 57-1992

COST CONCEPTS AND PROBLEMS UNDER STATE UNFAIR SALES AND PRACTICES ACTS

(Publication No. 21,428)

Jay Deardorff Cook, Jr., Ph.D.
The Ohio State University, 1956

The Unfair Sales Acts and Unfair Practices Acts, often referred to as sales-below-cost acts, were enacted by state legislatures for the purpose of curbing the practice of loss-leader selling. They prohibit the sale of products at prices below cost if the seller intended to injure competitors or destroy competition.

The dissertation is a study of alternative cost concepts that may be used in defining cost for the purpose of the statutes and also a critical analysis of the cost provisions of the acts. In addition, recommendations for the improvement of the definitions are made where warranted. It is hoped, therefore, that the dissertation will be of value to merchants, legislators, and teachers of marketing. It is not an evaluation of the social or business desirability of the acts, and it is further limited to the problem of defining cost for wholesalers and retailers. The comparable problem of defining cost for manufacturers is dealt with adequately in available literature.

State codes, publications of Commerce Clearing House, Inc., and the reporter series of the West Publishing Company were used extensively for the analysis of cost provisions, court interpretations, and administrative aspects of the acts. Information concerning cost concepts and the problems involved in defining cost was obtained from numerous other published sources.

Four classes of acts are distinguished according to the definition of cost; namely, (1) Unfair Practices Acts, (2) Unfair Sales Acts, (3) miscellaneous acts, and (4) special acts. The first three classes apply to all products, whereas each act in the fourth class applies only to one industry or to a few specified industries. The Unfair Practices Acts, enacted in six states, as well as some special acts, prohibit loss-leader sales, the minimum price being defined as the full cost of the product. The concept of cost utilized is the unit product cost as determined by accountants rather than the average unit opportunity cost of the economist or the cost as viewed by businessmen. The Unfair Sales Acts, in effect in sixteen states, permit loss-leader sales but limit the extent of loss by the prescription of minimum percentage markups that are presumed to cover only a part of the merchant's overhead expenses. A few acts prohibit predatory loss-leader sales by defining the minimum price as the acquisition cost of the product.

The most difficult problems of analysis are encountered in connection with overhead expenses. As a prime example, the acts that prescribe a full cost definition do not indicate the method by which overhead costs are to be allocated to products. Some courts and administrative agencies have ruled that an average allocation is to be made; others have required a specific allocation. The former method obviously does not agree with pricing practice. The latter method, among other problems, may involve discrimination because some merchants may not be able to make a proper specific allocation. Research directed to discovery of the extent of this discrimination is sorely needed. The percentage markups prescribed in the Unfair Sales Acts enable a relatively easy determination of the minimum price. It is, however, very important that

the prescribed markup be low enough to prevent prices from being fixed at too high a level. Further research would be helpful in determining proper markups for various kinds of marketing institutions and products.

244 pages. \$3.15. Mic 57-1993

THE MULTI-LINE FIRM IN RELATION TO COMPETITION

(Publication No. 21,176)

George Alfred Elgass, Ph.D.
University of Michigan, 1956

The purpose of this study is to identify and analyze the considerations that must be evaluated in determining whether multi-line activity strengthens or weakens economic competition, and to arrive at tentative judgments such as can be based upon deductive reasoning and general observations of the economy.

Despite the fact that economic theory has largely been developed upon the premise that each firm produces only one product, most modern firms make several products, and the production of goods in different fields or industries is not uncommon. Firms which produce such diverse goods as pharmaceuticals and food products, television sets and air conditioners, or automobiles and household appliances are illustrative of multi-line output.

The market structures which result from multi-line firms are substantially different, however, from those associated with specialized firms, and there is a question as to whether competitive forces are strengthened or weakened by the development of multi-line enterprises. The relationship of the multi-line firm to competition is of practical as well as theoretical importance, for in our economy competition is quite generally accepted as the principal regulator of economic activity.

Initially, consideration is given to the development and extent of multi-line firms. This type of firm is not new. History shows that there were large diversified firms in medieval times. The coming of the Industrial Revolution, however, led to the dominance of the specialized firm. Later, a renewed interest in diversification developed, and in recent years there has been a strong trend toward multi-line diversification.

The analysis of the relation of the multi-line firm to competition is complicated by the lack of a consensus as to the detailed characteristics of competition. It is necessary to consider a number of different concepts of competition.

First, the concepts of perfect and pure competition are intensively examined. In spite of their apparent practical limitations, perfect and pure competition are widely used as the standards in the appraisal of actual markets, and they also are widely held up as desirable ideals. Multi-line output is seen to conflict with perfect and pure competition on several bases. Consequently, some persons would conclude that multi-line firms are undesirable. Unless perfect and pure competition are truly desirable ideals, however, this conclusion is unwarranted. A critique of these concepts as desirable ideals demonstrates that perfect and pure competition do not merit this ideal status.

Next, attention is focused upon the concept of "workable"

or "effective" competition. The structural and performance approaches to workable competition, together with the view of the combined use of these approaches, are discussed. In this study, workable competition is viewed as a dynamic process wherein market structure, behavior, and performance are closely interrelated. An effort is made to recognize these interrelationships as both structural and performance indicia are employed in the analysis of the relationship of multi-line output to workable competition. Finally, special consideration is given to the very large multi-line enterprise which has received some special criticism as being incompatible with workable competition.

General Conclusion. It is felt that on the basis of the considerations bearing upon competition identified and analyzed in this study, the multi-line enterprise is generally not only consistent with workable competition, but also tends to strengthen it, and that the large conglomerate enterprise need not be excluded from this generalization. The multi-line firm should not be considered suspect--there is nothing inherent in multi-line output which makes it inconsistent with workable competition. Indeed, on several counts it strengthens competition. This conclusion, of course, does not constitute a judgment of the effect of multi-line output in a particular market. This would require a detailed study of the specific market.

248 pages. \$3.20. Mic 57-1994

THE CHANGING COMPETITIVE POSITION OF DEPARTMENT STORES IN THE UNITED STATES BY MERCHANDISE LINES

(Publication No. 21,432)

Robert David Entenberg, Ph.D.
The Ohio State University, 1956

Over the period 1929-1955, department store sales, while increasing absolutely, decreased relatively from 9.0 per cent to 6.6 per cent of total retail store sales. Department stores have relied principally on programs of suburban expansion to halt or reverse this trend without noticeably affecting their total competitive position.

The purpose of the study was to analyze department store experience by individual merchandise lines in relation to total national sales of each line. To do this, it was necessary to develop data to measure annual sales for each of 44 department store merchandise lines and total national sales for the same lines in all classes of outlets. The results showed considerable variation among the lines individually analyzed. These were divided into six groups:

Group I consists of merchandise lines in which department stores have gained relative position and the physical volume of market sales has more than doubled since 1929, as shown in the table on the following page. Similar data are given for each of the lines in the other five groups.

Group II includes 20 departments in which department stores gained or maintained (in one case) relative position and the physical volume of market sales increased but was not doubled. This group includes the following major sales volume departments: "Girls' and Teen-age Wear," "Women's, Misses' Coats and Suits," and "Curtains, Draperies, Upholstery, etc."

Merchandise Line	Per Cent Gain in Mkt. Position (1929-1953)	1953 Mkt. Sales as a Per Cent of 1929 Mkt. Sales in	
		Current Dollars	Physical Volume ¹
D-23 Aprons, housedresses, uniforms	81.8	691	4.0 Times
G-43 Restaurant and fountain	28.6	487	2.8
C-11 Handbags, small leather goods	21.5	357	2.1
G-49 Service department sales	14.5	422	2.4
A-4 Domestic, blankets, spreads	12.0	511	2.9
C-14 Corsets and brassières	6.3	426	2.5

Group III includes six lines in which departments gained relative position and the physical volume of market sales decreased. The major sales volume department in this group is "Women's and Children's Hosiery."

Group IV includes seven lines in which department stores lost relative position although the physical volume of market sales more than doubled. Principal sales volume departments in this category are: "Major Household Appliances," "Toys, Sporting Goods, etc.," "Blouses, Skirts, Sportswear," and "Infants' Wear."

Group V consists of four lines in which department stores lost relative position and the physical volume of market sales increased but was not doubled. The major sales volume department in this group is "Underwear, Slips, Negligees, Robes."

Group VI consists of only one line, "Silks, Velvets, Synthetics, Woolens," in which department stores lost position and the physical volume of market sales decreased.

Although department stores improved their competitive position in 31 lines, they still lost over-all relative position, simply because they increased their share of the market largely in lines for which consumers are spending proportionately less. Conversely, lines in which department stores have been receiving a smaller or comparatively stationary share of the market are those for which consumer expenditures have been expanding. In many cases, the lines in which department stores show the greatest dollar strength are the very ones in which they have been losing the greatest potential business.

The study furnishes a means whereby department stores can examine critically their changing relative position in each of their merchandise lines and redirect their promotional efforts into both merchandise line and suburban expansion. Conceivably, such a combined approach could lead to a reversal or a halting of the declining competitive sales position of department stores in our retailing system.

265 pages. \$3.45. Mic 57-1995

1. Current Dollars
173 (Retail Price Index)

MANAGEMENT INSTRUCTION IN THE UNITED STATES AIR FORCE ACADEMY CURRICULUM

(Publication No. 21,472)

Floyd Graham, Ph.D.
The Ohio State University, 1957

As the economic activities and the population of the United States have grown, many groups have recognized

the contribution which managerial skills can make to the solution of problems raised by such growth. Expressions of this recognition are most commonly heard from industry and commerce. Yet there are indications that a need for better management capability also exists in other than the business segment of the national economy; in particular, the professional fields. It is with these fields that the dissertation is concerned.

The basic problem to be explored in the dissertation is whether or not professional undergraduate curriculums should include training in management. It would be desirable to explore all professional fields in seeking an answer to this question. Such a task was beyond present time and resources, but it was found that useful conclusions could be reached from an intensive study of one professional field. This is the profession of the officer in the United States Air Force.

The first task of the study was to determine the professional status of the Air Force officer. This was done by a comparison of the job specifications for the military officer, engineer, teacher, doctor, lawyer, and minister, and also by obtaining the opinion of experts in these fields. The study further demonstrated that the officer, along with members of other professions, must have a reasonable degree of management knowledge and skill to do his job properly. To determine the desirability of attempting to develop that skill by management training at the Air Force Academy, and to investigate methods of providing such training, the writer conducted one hundred and seventy-seven interviews with military, business, and industrial persons and prominent educators throughout the United States. The information obtained from interviews was supplemented by library research. Secondary sources were not very helpful, however, since little has been written about management training for professional occupations.

The first and most important conclusion reached was that management training should be included in the curriculum of the Academy. In such training, certain phases of management should be emphasized, while others should be presented for purposes of familiarization only. The second major conclusion drawn was that the training should be geared to situations which occur at the squadron level of Air Force organization. These situations would be typical of the officer's initial experience on active duty, since the squadron is the lowest level of formal organization in the hierarchy of Air Force organizational structure.

Supplementary findings included the desirability of interweaving management instruction with other phases of the curriculum; establishing a separate block of management instruction in the senior year schedule; and employing a functional type of instruction.

Similar conclusions seem applicable to other professional areas. Specific applications of the recommendations to other professional fields would require further study to insure specifications of details suited to the particular curriculum needs.

178 pages. \$2.35. Mic 57-1996

BUILDING CONSTRUCTION AND
BUSINESS CYCLES, 1870-1938
(PARTS I AND II)

(Publication No. 20,586)

David Theodore Lapkin, Ph.D.
Columbia University, 1957

Economists have long been concerned with the subject of investment in their attempt to understand the nature of cyclical change in an enterprise system. Their interest stems largely from two properties of this variable. First is the magnitude of investment as a component of the gross national product and second is its volatility.

The interest in investment has led to inquiries regarding its components. The cyclical behavior of building construction - one of the most substantial and unstable elements in aggregate investment is the subject of the present study.

The study falls logically into two parts. The first is concerned with a cyclical analysis of building construction by type of structure. It involves the breakdown of the aggregate value of building construction into, speaking broadly, residential and nonresidential building. The second area of examination relates to the cyclical analysis of the size distribution of commercial and industrial buildings. That is, the cyclical behavior of the volume of building construction can be conceived as involving changes in either or both of two variables; changes in the number of buildings constructed and/or changes in the average size per building. The second part of this study deals with the cyclical behavior of one of these variables - that of average size per building.

We want to know if the average size of buildings increases when the volume of buildings increases, and decreases when the volume of building diminishes. Changing the frame of reference slightly we also seek to find out whether the average size of buildings expands and contracts with the rises and falls of business at large.

The data underlying Part I of the study in which the cyclical behavior of residential and nonresidential building is measured and analyzed are the annual building permits of over 400 American cities which run from 1870 to 1938. These data include the value of permits for the following four building series: 1) residential housekeeping dwellings; 2) residential nonhousekeeping dwellings; 3) nonresidential building; and 4) an aggregate series which is the sum of the permit values in the three aforementioned categories.

Part II which contains the analysis of the size distribution of buildings is based on monthly permit data for commercial and industrial buildings for six cities; Boston, Cleveland, Los Angeles, Manhattan, Milwaukee and Pittsburgh. These data cover the period 1870 to 1919. Additional information on average floorspace of commercial buildings derived from Dodge contract awards carry the study forward to 1938.

Our results can be stated briefly:

1. The two principal types of building, residential housekeeping and nonresidential building respond with considerable regularity to the fluctuations in general business as dated by the National Bureau of Economic Research. That is, in approximately 80 percent of the cycles studied, these two series rose as business expanded and fell as business contracted. Residential nonhousekeeping building responded somewhat less and the total value of all building slightly more consistently.

2. The timing of nonresidential building typically coincides with the movements of business at large, while the other three series turn down before the peak is reached and turn up synchronously with the recovery of business.

3. The amplitude of fluctuations in all building series is marked and the duration of cycles in building average about 3 1/2 years.

4. The average size of commercial and industrial buildings manifested a close relationship to changes in the total volume of such buildings, rising and falling as the volume of building rose and fell. The average size of buildings does not tend to respond as consistently to business cycles, however.

5. The average size of buildings appears to fluctuate in long cycles whose durations approximate the long cycles in the total volume of building.

302 pages. \$3.90. Mic 57-1997

VALUE ADDED AS A MEASURE OF ECONOMIC
CONTRIBUTION BY MARKETING INSTITUTIONS

(Publication No. 21,489)

David Danny Monieson, Ph.D.
The Ohio State University, 1957

One purpose of the study is to develop a feasible concept of value added by marketing institutions in the American economy, and the other is to give this concept quantitative expression. To these ends it was necessary to know (1) whether a logical premise for the concept could be evolved, (2) whether a method for measuring value added by marketing institutions could be formulated, and (3) whether some significance of the derived concept and measure could be disclosed.

An intensive survey of existing literature contributed to the premise that value added is an income concept; it is the income apportioned to the firm's factors of production as remuneration for their aid in creating economic value. Value added by a marketing institution is, then, its contribution to the Gross National Product.

The synthesis of quantitative trade association and government data resulted in an estimate of value added by the trade sector for the year 1948. The money value was 53 billion dollars, or 20 per cent of Gross National Product. Of this amount, 34 billion dollars emanated from the operations of the nation's retail establishments, and 19 billion dollars were contributed by the nation's wholesale establishments. The 1948 value added estimates were further classified by census kinds of retail and wholesale establishments, by census geographic divisions, by major metropolitan areas, by legal organization, by sales volume size, and by single and multiunit groups.

Analysis of the value added estimates suggested that the value added measure corresponded with the majority of alternate indicators of economic contribution but differed from the sales volume indicator when a more refined analysis was performed. Value added ratios, when applied to a trade industry analysis or a time series analysis of retail and wholesale establishments, produced a more realistic and more consistent pattern of results than did sales volume ratios. Value added seemed particularly appropriate for single firm analysis of such items as sales performance and profits. The value added measure also

indicated its plausibility in other aspects of economic analysis such as public finance, productivity, economic concentration, and social performance.

The most significant conclusion of the study is that an integrated concept of value added by marketing was realized. Existing gaps in statistical data permitted only a crude institutional measure. Because of the quantitative deficiencies, derived gross profit estimates were employed as realistic approximations of value added by the trade sector. The second conclusion, therefore, is that proper gross profit data would be a fundamental point of origin for measuring the value added by a marketing institution, and may well prove the implement for furthering research into source and technique refinement. It was further concluded that for pragmatic reasons the next improvement on the gross profit measure would be to adopt the United States Bureau of the Census' measure of value added.

Henceforth, research into marketing productivity or efficiency will have more clarified direction. An inventory of value added data over subsequent years will provide the numerator or output element of the productivity or efficiency index. A reappraisal into the nature of the denominator or input factor must be pursued if meaningful measures of marketing middleman productivity or efficiency are ever to be constructed.

A final conclusion is that value added holds great promise as a measure of output since, as a single index, the value added measure is now reinforced with a reasonable theoretical framework. 380 pages. \$4.85. Mic 57-1998

FUNCTIONAL DISCOUNTS: THEIR ECONOMIC AND LEGAL IMPLICATIONS

(Publication No. 21,491)

Henry Dean Ostberg, Ph.D.
The Ohio State University, 1957

Functional discounts are reductions from a list price given to persons or firms operating at the wholesale level of distribution, presumably in order to compensate them for the marketing functions they perform. Such discounts are granted by many American sellers and especially by manufacturers in the consumer-goods industries. Much misunderstanding, nevertheless, exists with regard to the precise nature and the legal and economic implications of functional discounts.

Functional discounts are a much more complex manifestation than appears to be generally recognized. One simple fact should be clear, however. This is that the size of functional discounts is not necessarily related to the cost savings which a manufacturer may realize as a result of selling through wholesale middlemen rather than directly to retailers or industrial consumers. In many industries, wholesale middlemen constitute the only efficient and effective channel of distribution, with the result that a manufacturer in the industry possesses little or no choice in selecting the channel he will use. If he wishes to sell at all, or at reasonable expense, he must secure distribution through these wholesale middlemen. Frequently, the most effective method of obtaining this distribution is to offer wholesale middlemen functional dis-

counts large enough to cover the costs of handling and selling the manufacturer's line and leave a reasonable net profit. Consequently, the margin requirements of middlemen carrying the line, rather than any estimate of cost savings to the manufacturer, must normally be the basic determinant of the size of functional discounts. This rather obvious fact is, surprisingly, not generally comprehended.

No one-dimensional viewpoint of functional discounts can, however, adequately reflect their many-sided nature. The following are three of the six different explanations which are developed in the study to indicate the various reasons why functional discounts are granted by sellers: (1) Functional discounts compensate middlemen for the performance of indispensable wholesale functions. (2) Functional discounts constitute a factor in the competition between different sellers to secure distribution through the same wholesale middlemen. The granting by a manufacturer of slightly larger discounts than his competitors offer is often the most effective way to induce wholesalers to carry the manufacturer's line. (3) Functional discounts are frequently granted in order to permit several channels of distribution, with different marketing costs, to compete with each other in the resale of a line.

The Clayton Act, as amended by the Robinson-Patman Act, prohibits a seller engaged in interstate commerce from discriminating in price as between different buyers of "like grade and quality" where specified injury to competition is likely to occur, unless such discrimination can be justified pursuant to one of the defenses authorized by the Act. The passage in 1936 of the Robinson-Patman Act as an amendment to the Clayton Act had the effect of casting a long shadow of doubt on the legality of functional discounts, which, after all, involve charging a lower price to wholesale middlemen than to direct-buying retailers for goods of like grade and quantity.

A study of the legislative history of the Robinson-Patman Act and an analysis of the administrative and judicial decisions under the Act indicate clearly, however, that no doubt need ever have arisen regarding the permissibility of functional discounts under the Robinson-Patman Act. The Act prohibits only price differences which injure competition, and true functional discounts are not likely to cause any harm to competition. Many problems are, however, commonly encountered in the process of granting functional discounts to qualified purchasers. These are explored fully in the study.

340 pages. \$4.35. Mic 57-1999

THE THEORY AND TECHNIQUE OF COST ACCOUNTING IN THE HOSIERY INDUSTRY

(Publication No. 13,756)

Albert Weyman Patrick, Ph.D.
University of Michigan, 1956

The purpose of this study is to present the theory underlying standard costs and to suggest techniques for their use in the hosiery industry. The unsound costing methods employed by many companies have resulted in part from the nature of the industry itself and in part from the dearth of material on the application of proper costing

procedures to problems peculiar to hosiery manufacturing. This lack of material on the subject and the importance of good costing in periods of highly competitive economic conditions provided a stimulus for this study.

Although the study has not been formally divided into sections, the material has been presented in such a way that it falls into three parts: (1) the history of the knitting industry, and the economics of the hosiery industry; (2) the theory of standard costs; and (3) techniques and methods for employing standard costs in a hosiery manufacturing company.

The first two sections, which include Chapters I through III, primarily provide background information for the last section, Chapters IV through XII. Although the first three chapters are not concerned with cost accounting in the hosiery industry, they are nevertheless intimately related to the last nine chapters.

Discussions of the problems encountered in setting standards for the various components of manufacturing costs are presented in Chapters V through VIII. The cost sheet and its uses are set forth in Chapter IX. The incorporation of standard costs into the accounts through the medium of journal entries is illustrated in Chapter X, along with detailed examples of the analysis of departmental variations. Chapter XI stresses the importance of good reporting, and presents several examples of reports which should be useful to management. Chapter XII provides a summary of the conclusions and recommendations of the writer.

No attention has been given to costing for yarn processing or to setting standards for selling and administrative expenses. The work deals only with accounting for costs of manufacturing hosiery. No cost system as such has been developed. Rather, this endeavor has been aimed at a discussion of the problems of standard cost accounting, and it does not attempt to develop bookkeeping procedures in the sense of constructing forms, adapting mechanical equipment to particular data-collecting jobs, or even developing a chart of accounts. With applicable principles, these matters can be best handled by those who have an intimate knowledge of the technical limitations of resources available to each firm.

The results of the study indicate that sound costing methods are important in the hosiery industry both for purposes of cost control and for use in establishing selling prices.

General conclusions which can be drawn from this study may be summarized as follows: (1) standard cost accounting should be employed, (2) cost standards should be established for each component of manufacturing costs, (3) practical capacity should be used as the capacity basis upon which to set burden standards, (4) inventory figures for each quality of goods should be determined in such a way that they are proportional to the selling prices of those goods, and (5) an adequate system of comparative internal reports should be devised in order that those responsible for the incurrence of costs will be notified immediately of the results of their operations.

416 pages. \$5.30. Mic 57-2000

THE GOING CONCERN CONCEPT IN ACCOUNTING

(Publication No. 20,895)

Dorsey Edward Wiseman, Ph.D.
University of Illinois, 1957

The postulates of accounting, among them the going concern concept, have been characterized as habits of mind. Almost every writer who has attempted a reasonably complete exposition on accounting has stated or implied acceptance of the going concern concept. In few cases, however, has there been any attempt to sketch other than the barest outline of the going concern concept. This study has the following purposes: to set forth:

- (1) The nature of the going concern concept
- (2) The place of this concept in accounting
- (3) The consequences of the use of the concept
- (4) The social significance of the concept.

A comprehensive version of the going concern concept entails consideration of the life of the firm, the legal and social framework surrounding the accounting entity, the productive and distributive aspects of the enterprise, the financial plans of the organization, the management of the business unit, and the proprietor's expectations. The life of the enterprise may be assumed to be indefinitely long unless there is clear intent and circumstances to indicate otherwise. In addition it may be assumed that the basic ownership and managerial objectives, plans, and policies will be continued in a substantially unaltered manner in the future. Underlying the whole going concern concept is the assumption that there will be a reasonable stability of the institutions of our economic society.

The going concern concept in accounting provides a point of view to facilitate and implement assembling, communicating, and interpreting enterprise financial information. However, there is not complete unanimity of opinion as to the application of the going concern concept to the financial data of the firm. Also there has been a continuing evolution in accounting and a concomitant refinement in the application of the going concern concept in accounting.

The highest degree of objectivity in accounting is the best, provided attainment of that high degree does not run counter to the long-run point of view of a going concern. A complete application of the going concern concept would call for a reporting of those income generating activities which do not appear in current conventional reports. The going concern concept also would support an expanded use of the deferring of appropriate costs and their proper assignment to subsequent periods. From a broad view the going concern concept would be compatible with either a historical cost or a replacement cost approach to inventory and fixed asset accounting. The going concern viewpoint coordinated with the legal viewpoint may furnish a more significant presentation of liabilities. From the standpoint of the going concern concept the liability category may include more than those inescapable amounts payable to creditors under established contractual agreements. The firm also may encounter situations which lead to liquidation, reorganization, combination, and other unusual situations. The underlying assumptions of the going concern concept may be viewed as the criteria to apply to determine the going concern aspects of these special situations. Also the underlying assumptions may be considered as standards or points of departure for the development and the application of procedures to meet the exigencies of the special situations.

214 pages. \$2.80. Mic 57-2001

ECONOMICS, FINANCE

SOME INVESTMENT ASPECTS OF TIMBERLAND
OWNERSHIP IN NEW ENGLAND, THE SOUTH AND
THE LAKE STATES FOR SELECTED OWNERS
WITH SPECIFIC REFERENCE TO OWNERS
IN NEW ENGLAND

(Publication No. 20,781)

Frederick Amling, Ph.D.
University of Pennsylvania, 1957

Supervisor: Dr. Julius Grodinsky

Financial data on values, costs and income have been unavailable to corporations and individuals interested in the profitability of timberland ownership. This thesis considers three objectives to provide this information. First, what is the present and future rate of return on timberland investments operated to produce a continuous succession of forest products? Second, is the present and future rate of return satisfactory? Third, what criteria must be met for timberland to be a desirable investment? Specific reference is made to owners in New England, although data are presented for owners in the South and Lake States.

Information was unavailable from secondary sources since a study of this type has not been previously undertaken. To collect data, it was necessary to conduct personal interviews with timberland owners who operated their timberland for a profit under conditions of good forest management and who would be most likely to have financial records. The major portion of the field work was completed in the summer of 1954. Fifty-nine large scale owners who held 17,555,000 acres of timberland provided usable data.

The rate of return earned on timberland by the New England owners was found to be 1.74 percent, compared to 1.41 percent for the owners in the South and .56 percent for owners in the Lake States. These rates were found by dividing the weighted average 1953 net income by the 1954 weighted average estimated timberland value per acre, except for New England where net income was an estimated average for the years 1949-1953. The rates earned by the New England owners ranged from -.87 percent to 10.19 percent; in the South, -2.02 to 5.97 percent and in the Lake States, -7.87 to 6.24 percent.

The future estimated rates of return, based on limited assumptions and covering a 60-year period were somewhat higher. The future average rate of return for owners in New England was estimated to be 5.4 percent compared to 8.79 percent for owners in the South and 7.2 percent for owners in the Lake States. The increase in stocking will add 1.02 percent compounded annually to these figures for owners in New England, .70 percent for owners in the South and .71 percent for owners in the Lake States.

Two criteria were used to determine if the rates were satisfactory. One was the rate of return the owners anticipated. The second was the rate of return that could be obtained on other investments. It was found that timberland investment was unsatisfactory when current yields were compared with what the owners anticipated and what could be earned on other investments, some of which bear less risk than timberland. Timberland investment appears to be attractive and satisfactory when future estimated returns were compared to the owner's anticipated rate. It

also compared favorably with other investment media except for New England timberland in comparison with current yields on common stock. When the increment of value resulting from increased growing stock is considered the future estimated rate is satisfactory for all owners in comparison with other media.

The following data must be obtained or conditions exist to insure successful timberland investment: an inventory of timber, an estimate of growth, a valuation of the tract, estimates of operating income, costs and net income, some estimate of the present and future rate of return, adequate markets, the timberland must be managed and protected, and the ownership should be long term and continuous.

CONCLUSIONS

In addition to the conclusion drawn about the satisfactory nature of the rate of return discussed above, the following conclusions were reached:

1. New England owners were in the best financial position with respect to the current yield. The Southern owners were in second position and the Lake States owners were in the poorest position.
2. Over a sixty-year period, the estimates indicated that the Southern owners would be in the best financial position, the Lake States owners second, and the New England owners poorest. Thus future profit possibilities were considered to be greatest in the South.
3. The rates of return on timberland were low with a wide range in the rates.
4. Timberland must be held for a long period of time if the greatest financial returns are to be earned.
5. Timberland is most profitable if operated intensively to obtain the greatest growth, operating income and net income.
6. Adequate markets are important to timberland ownership and investors must take cognizance of all the risks involved.
7. No one rate of return was suggested as the acceptable rate.
8. It is thought that timberland that did not provide a current rate of return that was satisfactory or future prospects for an adequate return should be sold.

190 pages. \$2.50. Mic 57-2002

KEYNESIAN IDEAS AS REFLECTED IN THE
DOMESTIC FISCAL AND MONETARY POLICIES OF
THE UNITED STATES, 1945-1953

(Publication No. 20,091)

John Roger Fredland, Ph.D.
The American University, 1957

Problem: To what degree have the doctrines and theories of John Maynard Keynes influenced U. S. economic policy in the post-war period (to January, 1953)?

Fiscal Policy: Ascribing to Keynes a "vision" of secular stagnation and equilibrium at less than full employment; an aggregative economic "model" in which National Income is determined by levels of scheduled savings, scheduled investment, and consumption expenditure; policy

recommendations emphasizing public works, a tax system making for more nearly equal income distribution, and increased social services, the writer argues that Keynes' influence on U. S. policy, though one of many influences, has been considerable. It has been manifested in the debate on the Murray Bill, in the writings of the Council of Economic Advisers, in the speeches of the President, in policy statements made at hearings of the Joint Committee on the Economic Report.

The Keynesian "vision" coupled with historical experience to exercise an untimely influence on post-war economic thinking in and out of government until the outbreak of the Korean War in June, 1950. Too much fear of deflation and depression led to a tardy recognition of the pervasive problem of inflation.

Acceptance of countercyclical fiscal policy in accordance with the Keynesian model became rather general during the period, and was reflected in the Congressional action in raising taxes promptly after the Korean outbreak. **Monetary Policy:** Identifying as "Keynesian" the "liquidity preference" theory of interest, an emphasis on fiscal policy as more effective than monetary policy, low interest rates with a minimum of uncertainty, acceptance of a "managed currency" as a permanent feature of the economy, and the "delayed purchasing power" concept, the writer argues that though the influence of Keynes is largely indirect, it did have some impact on the thinking both of Treasury and Federal Reserve officials. Reference is made to the periodic publications of both agencies, and to the policy statements of leading officials. The background of the Treasury-Federal Reserve "Accord" of March 1951 is explored.

Conclusions: (1) For better or worse, Keynes has had an influence on policy; (2) The mechanisms set up by the Employment Act have been at least partially effective; (3) The monetary and fiscal policies of the United States in the period 1945-1953 were on the whole more internally consistent than in earlier periods. The "New Economics", of which Keynes is surely the godfather, if not sole creator, has already won sufficient acceptance to be regarded as the "New Orthodoxy." 388 pages. \$4.95. Mic 57-2003

THE CURRENT BANK-MERGER MOVEMENT: AN ECONOMIC APPRAISAL

(Publication No. 21,487)

Robert Herman Marshall, Ph.D.
The Ohio State University, 1957

The study describes and evaluates the major economic aspects of the current bank-merger movement, which has gained especial impetus during the post-World War II period. In general, an appraisal of over-all merger activity is presented, with occasional references to particular groups of banks in specific areas.

The bank-merger trend during the period 1946-1956 is explicable primarily in terms of the banking industry's attempt at adaptation to the changing institutional complex in which it operates.

Significant economic factors contributing to mergers include (1) attempts of banks to enhance market positions through diversification of operations, particularly in the growing area of "retail banking"; (2) adaptation to appre-

ciable population shifts into outlying, suburban areas through the acquisition of "ready-made" banking facilities, which are often more legally accessible than *de novo* offices; (3) adjustment to the enhanced role of commercial lending which has pressured banks into mergers to offset lagging growth in deposits and business, to expand legally established loan limits, to meet the rising competitive pressure of non-bank lenders, and to forestall officer shortages; (4) moves to offset the undervaluation of bank shares and to augment financial prestige.

Major noneconomic factors operative in mergers include (1) the gradually eased laws governing bank mergers, modified by the lack of explicitly stated bench marks to be used in appraising mergers; (2) the varied pattern of states' laws governing the scope of branch banking, and the more stringent requirements for satisfying the "need" criterion in the establishment of *de novo* branches as compared with the acquisition of branches via merger; (3) personnel-management considerations that promote the absorption of relatively small banks by larger banks that pursue a generally more attractive, enlightened personnel policy.

The study indicates that the impact of the bank-merger movement upon banking concentration has been very slight. The one hundred largest commercial banks hold a smaller proportion of United States banking resources than they did before World War II. In addition, the absolute and relative standing of intermediate-sized banks has increased in recent years.

The monopolistic-competitive market structure of commercial banking and its highly regulated, supervised nature require that an appraisal of bank-merger activity consider additional factors besides the state of numerical competition in an area.

Aspects of a "workable competition" approach in evaluating bank mergers include: the nature of the assets, capitalization, and management of the resulting bank; the composition of the prospective absorbed bank's assets and management group; the impact of the merger plan on the participating shareholders; the effect on the banking convenience and needs of the community concerned; and the satisfaction of all legal requirements.

One recommendation comprises statutory amendments requiring the initial consent of a federal bank-supervisory agency for bank mergers. Consent would be necessary for any merger transaction that resulted in a continuing or absorbing bank subject to federal supervision.

In judging any merger proposal, the amended laws should explicitly require the consideration of both competitive effects and relevant banking factors.

A further recommendation entails the establishment of a unified national banking system that would permit at least uniform state-wide branch banking. The latter modification would facilitate the regulation of bank mergers and provide for a more viable banking system.

An appraisal of the various elements affecting the future course of merger activity indicates that, on net balance, the factors reducing the impetus of the bank-merger movement are growing in force.

292 pages. \$3.75. Mic 57-2004

ECONOMICS, HISTORY

THE ECONOMIC AND FINANCIAL DEVELOPMENT
OF OKAYAMA PREFECTURE, JAPAN

(Publication No. 21,191)

James A. Kokoris, Ph.D.
University of Michigan, 1956

The object of this study is to examine local economic and financial development in Japan by focusing attention upon Okayama Prefecture. Emphasis is placed on financial institutions and their place in the life and growth of the prefecture.

The field research upon which this study is based was done primarily in Okayama Prefecture, Japan. Studies and travel were conducted during the year July, 1951 to June, 1952, from a base of operations located in Okayama City, where the field station of the Center for Japanese Studies, University of Michigan, was located.

In order to present the local area in its national setting, the place of Okayama in the economy of Japan is analyzed. An examination is then undertaken of the economic and financial organization and monetary problems of the Okayama feudal fief during the Tokugawa era (1603-1867). The period of transition from a feudal to a modern economy is studied with special attention being given to the national banks at the local level. These banks were the forerunners of modern banking institutions in Japan and played an important role in Japan's development. An important institution in the modern economic development of Japan has been the zaibatsu or financial oligarchy. In Okayama, the Ohara local zaibatsu developed primarily within the prefecture. This permitted the study of dominance in local financial and industrial activity paralleling similar dominance on a national scale by zaibatsu such as Mitsui, Mitsubishi, etc. The evolutionary development of local banking leading to the establishment of the Chugoku Bank -- the principal local bank of Okayama -- is studied in detail and the place of this bank and other local financial institutions in the economic life and growth of Okayama is analyzed.

As a result of this study it is shown that the outstanding characteristic of the economy of Okayama from feudal times until the present has been the importance of agriculture. Gains in agricultural productivity were of considerable significance in the industrialization of both Okayama and all Japan. In spite of a relatively well developed agricultural sector, per capita income in the secondary industries is higher than in agriculture and on balance per capita income in Okayama is below the national average.

The significance for Okayama, as well as for all Japan, of the financial disorders and collapse of Tokugawa feudalism is related to the overthrow of institutions incompatible with modern economic development. Although Meiji reforms brought a greater degree of nationwide unity, early development activities in Okayama were in general locally initiated. Wars and economic crises hastened the integration of Okayama with the national economy -- the high point coming in World War II. However, a considerable degree of local independence of banking and industry exists in Okayama. This is exemplified by the Chugoku Bank and the industries of the Ohara local zaibatsu.

The following general observations emerge from this study: The rich agricultural sector of Okayama played an

important part in the economic development of the prefecture. Development in the early Meiji era was financed in part through note issue of local banks and through pension funds received by the dispossessed local feudal nobility. A surplus of agricultural savings was redirected towards industrial investment. This resulted in a more balanced development in the local economy. The establishment of banks by entrepreneurs in order to finance their own industrial undertakings was of considerable significance in local economic development. The growth of local banking and industrial enterprise in Okayama has been closely related to the process of amalgamation and merger. In many respects, the general economic and financial development of Okayama Prefecture mirrors, in miniature, the pattern of modern development of all Japan.

409 pages. \$5.25. Mic 57-2005

ECONOMICS, THEORY

SOME EFFECTS OF SELLING EFFORT AND
PRODUCT QUALITY IN
A DYNAMIC MACROECONOMIC MODEL

(Publication No. 20,901)

Thomas Alexander Yancey, Ph.D.
University of Illinois, 1957

Two developments have taken place in the past thirty years in economic theory which have had an enormous impact on economic thought. In the field of microeconomics, the theory of monopolistic competition was developed by Professor Chamberlin with selling effort and product quality as variables considered by the firm, in addition to price, in maximizing profits. In the field of macroeconomics, a theory of aggregate income was put forward by Lord Keynes and was extended to the dynamic case by Professor Domar and Mr. Harrod.

This study presents a theoretical discussion of the effects of price, selling effort, and product quality on aggregate demand and makes an empirical examination of the effect of selling effort, as represented by advertising expenditures, on consumption in the United States in the period from 1869 through 1953. The theoretical discussion examines the effects of changes in price, selling effort and product quality on the equilibrium rate of growth and the stability of the model, and it uses a three sector model made up of a producers' goods industry, a consumers' goods industry and households. Entrepreneurial actions concerning changes in the control variables are determined by unplanned changes in inventory. The model is made up of twenty-six linear difference equations, and the solution of this system involves a determinantal equation of the seventeenth degree. The electronic digital computer, "the Illiac," is used to obtain specific solutions using parameters obtained from statistical studies of real world data.

The empirical examination consists of two parts. First, an examination of the long run consumption function for the period from 1869 to 1928 to determine whether or not the function has been altered by selling effort in that sixty year

period. Second, econometric models with different specifications are constructed for periods from 1922 through 1953, and the effects of selling effort on consumption are examined. Estimates of parameters are obtained using both least-squares regression and the limited information single equation method of estimation.

Some conclusions drawn from the theoretical model are that increases in price and decreases in selling effort and product quality will raise the equilibrium rate of growth, and cutting price and increasing selling effort and product

quality will lower the equilibrium rate of growth. The stability of the model is not reduced by these parameter changes. The empirical examinations indicate that the data support the hypothesis that the long run marginal propensity to consume is affected by selling effort, but there is no evidence of change in the short run marginal propensity to consume that can be attributed to selling effort. Last, some comparisons are obtained on the effects of different model specifications on parameter estimates by least-squares regression and limited information estimates.

145 pages. \$2.00. Mic 57-2006

EDUCATION

EDUCATION, GENERAL

STATE-WIDE CO-OPERATIVE EFFORTS TO IMPROVE INSTRUCTION IN THE PUBLIC SCHOOLS

(Publication No. 21,424)

Charles Avery Blackman, Ph.D.
The Ohio State University, 1956

Teaching involves a twofold responsibility: that of working with students in a teaching-learning situation, and that of seeking continuously to improve the quality of the instructional program. Present-day thought has placed much emphasis upon the human factor in the second responsibility. Improvement of the school program involves much more than a change in curriculum guides or textbooks. It involves a change in people. While much is done at the level of the local school to help bring about change, there is a need for efforts at the state level.

The study is a description of certain activities carried on in Ohio to find ways of increasing the co-ordination of state-wide efforts for the improvement of instruction and to explore means of carrying on state-wide activities which seek to stimulate instructional improvement in local schools.

The directing principles are as follows:

1. The improvement of instruction is facilitated by the use of problem-solving techniques.
2. An individual is more apt to act on the basis of facts he, himself, uncovers than on facts presented by another person.
3. Principles of learning are applicable in instructional improvement activities.
4. Physical and emotional atmospheres affect the process of learning.
5. Effective use of the several media of communication enhances the probabilities of success as persons work together to solve problems.
6. Persons affected by decisions should participate in making them.
7. Existing groups and institutions should be used to the fullest measure possible. Be wary of setting up

new organizations if there is any existing instrumentality to do the task.

These principles were utilized to develop what has now become an annual conference to co-ordinate state-wide efforts to improve instruction; to arrange and administer a series of workshops dealing with instructional improvement; and to plan and conduct workshops for the training of leadership teams.

As the activities were carried on and appraised, the following were added to the original group of principles:

1. Outside consultants need to meet or surpass local expectations.
2. In some legally constituted organization, agency, or institution must rest the responsibility for following through on recommendations for action of conference groups and for continuously stimulating state-wide efforts at instructional improvement.

In addition to a description of the state-wide activities to promote instructional improvement, certain recommendations are made for furthering such activities.

321 pages. \$4.15. Mic 57-2007

THE RELATION OF CERTAIN ENVIRONMENTAL AND DEVELOPMENTAL FACTORS TO READING ABILITY IN CHILDREN

(Publication No. 20,815)

Lawrence W. Carrillo, Ed.D.
Syracuse University, 1957

PURPOSE: To determine whether certain characteristics of growth, development, and environment are associated with reading retardation.

PROCEDURES FOLLOWED: A parent questionnaire and interview were used to investigate the backgrounds of middle grade children of normal or higher intelligence who were: (1) reading adequately; and (2) severely retarded in reading. One hundred children were included in the study, fifty good readers from the Paramount schools, and fifty poor readers from the Long Beach schools.

Responses to the various items were tallied and compared first by inspection. Categorized data, where not obviously similar, were tested by the "t" test and Chi-square for significant differences.

RESULTS: The major differences were found to be these.

(1) Severe reading problems were much more likely to develop in children having more nearly average intelligence, rather than superior intelligence. (2) Poor readers tended to be males, showed comparative slowness in learning to dress themselves and in elimination control, tended to have severe problems in enuresis, tended to have more speech defects, and tended to be premature babies. (3) Neither parent of poor readers enjoyed reading as much as parents of good readers. (4) In school, poor readers liked arithmetic, but not spelling and reading; they liked fewer school activities in general, and did not like school in particular, when compared to good readers. (5) Poor readers had few peers in their neighborhood, had few friends, and did not adjust easily to residence change, even though likely to move often. Lack of adjustment is noticed in school progress, and they did not get along well in the class group. (6) Poor readers had a poor attitude toward their responsibilities, did not take them as a matter of course, and were not selected often for school leadership. (7) Parents of poor readers felt rather badly about their child's progress. They read to their child, since independence was impossible. These parents have talked to teachers at length, and special help had been provided. They wished for college attendance for their child, but did not expect it. (8) General comments of the parents of poor readers showed a history of conflict, tensions, and physical difficulties. However, they seemed to feel a necessity for blaming other persons, rather than constructively attacking the problem.

CONCLUSIONS: The conclusions based upon the findings of this study are:

1. Home environment was important in the genesis of reading ability, especially as it was concerned with parental attitudes of personal enjoyment in reading, acceptance of the school, and pride in their child's accomplishments. A neighborhood containing other children of the same age also seemed to be important.
2. The prenatal period and birth offered important data in diagnosis, since poor readers tended to have a history of: (a) delivery before full-term pregnancy; (b) size differential, being smaller at birth; and (c) injury at birth.
3. Developmentally, important factors in the retarded reader's backgrounds seemed to be the following: (a) a slower development of verbal skills; (b) a higher likelihood of speech defect; (c) a slowness in elimination control and a definite tendency toward enuresis; and (d) a slower motor development.
4. Emotional history of poor readers seemed to reveal: (a) a lack of adjustment to change; (b) few friends; and (c) a lack of independence.
5. Socially, poor readers were characterized by one or more of the following: (a) a lack of selection for school leadership; (b) a poor attitude for responsibility; and (c) a lack of adjustment in the class group.

6. Intellectually, poor readers were average rather than superior, and did not like school or school activities as well as the good readers.

7. Poor readers were usually males.

228 pages. \$2.95. Mic 57-2008

A STUDY OF THE WAYS IN WHICH EDUCATIONAL PERSONNEL, PARENTS, PUPILS, AND OTHER CITIZENS PARTICIPATE IN SECONDARY SCHOOL CURRICULUM DEVELOPMENT IN OHIO

(Publication No. 21,240)

Burton William DeVeau, Ph.D.
University of Minnesota, 1957

Adviser: Nelson L. Bossing

Purpose

It was the purpose of this study to: (1) discover the individuals and groups who participate in secondary school curriculum development programs in Ohio; (2) determine the ways in which individuals and groups participate in curriculum development; (3) determine the roles administrators and education officials in Ohio believe individuals and groups should practice in secondary school curriculum development; and (4) establish criteria to serve as guides for individuals and groups in Ohio who in the future may desire to participate cooperatively in curriculum programs.

Methods and Procedures

All types of literature associated with the problem area were read and examined. Examples of state and local programs were studied. Previous studies, reports and case studies were examined. Recent literature in education were examined to determine the recommendations of modern writers concerning participation by individuals and groups in curriculum development programs.

A questionnaire was submitted to all teachers of courses in secondary school curriculum construction in approved teacher training institutions in Ohio, to Ohio Department of Education personnel, and to Ohio Chief Diocesan school officials to determine their opinions of individual and group participation in curriculum development. Fifty-five per cent of these questionnaires were returned and utilized.

A questionnaire was sent to the administrators of all city and to one-third of all county, exempted village, and private and parochial schools in Ohio to: determine who participates in curriculum development and their respective roles; determine the individuals and groups the administrators want to participate and their recommended roles for these groups. Seventy-five per cent of these questionnaires were returned and utilized.

Ten selected schools were visited to determine how participating groups became interested in curriculum development.

Summary and Conclusions

Extensive curriculum development programs are found in few secondary schools in Ohio.

College entrance requirements exert an important influence on the secondary school curriculum in Ohio.

The Ohio Department of Education is passive in curriculum development. Educators recommend that personnel of the Department serve as consultants and provide curriculum material.

Teacher trainers are not influential in curriculum development programs in Ohio. Educators recommend teacher trainers serve as consultants.

Curriculum specialists are available to a limited number of secondary schools. They participate in all curriculum activities.

Superintendents participate in almost all curriculum programs. Educators recommend participation by the superintendent in all curriculum activities.

The local school board plays a minor role in curriculum revision. Educators fail to recommend specific roles for the school board.

Principals are leaders in curriculum revision programs. Educators recommend leadership and committee participation for principals.

Teachers are active participants in curriculum development. Educators recommend teachers should participate in all phases of the local program.

Administrators report that parents play a minor role in curriculum development.

Educators recommend parent participation on curriculum committees.

Administrators report that students rarely participate in curriculum development. Educators fail to recommend specific roles for students except to participate in a manner acceptable to the local situation.

Educators recommend limited participation by lay groups in curriculum development in Ohio.

Administrators and teachers in Ohio are not trained to efficiently utilize and coordinate individual and group participation in curriculum development.

Participation in curriculum development is largely limited to professional groups in the secondary schools in Ohio.

Recommendations

A set of recommended roles for participation by Ohio Department of Education personnel, Ohio State Board of Education, teacher trainers, administrators, local school boards, teachers, parents and lay groups, and students in secondary school curriculum development are presented.

289 pages. \$3.75. Mic 57-2009

PATTERNS OF READING GROWTH: A LONGITUDINAL STUDY OF PATTERNS OF READING GROWTH THROUGHOUT THE SIX GRADES IN TWO ELEMENTARY SCHOOLS

(Publication No. 20,192)

Inez Clark Eddings, Ph.D.
University of South Carolina, 1956

Chairman: Josephine A. Piekarz

Purpose of the Study

The goal of this investigation was to identify patterns of reading growth found among a group of pupils during the

six grades of elementary school. A concomitant purpose was to identify factors that differentiate between the reading growth of boys and girls.

A review of the literature revealed that four variables were common to the opinions of the experts in the field of reading growth. The four variables -- intelligence, physical condition, environmental and experiential background, and emotional and social development -- were, therefore, employed as the areas of investigation for this study.

Procedures of the Investigation

One hundred and nine pupils enrolled in the sixth grade of two elementary schools in the Columbia, South Carolina, school system for the 1954-55 school term were selected to participate in this investigation. The only criterion for the selection of participating subjects was that they had been enrolled in the school for their entire elementary-school experience. In the light of conclusions reached from a review of completed scientific studies in the area of reading growth, appropriate instruments were either located or constructed to obtain information concerning the four variables accepted as bases for the investigation.

Three questionnaires concerning the environmental and experiential background of the subjects were constructed by the writer. These questionnaires were to be completed by the subjects, their parents and teachers. Other information concerning the yearly school attendance records of the subjects and their general reading achievement, as measured by standardized tests in the second through the fifth grades, was obtained from the school cumulative records in the offices of the respective school principals. Measures of the subjects' general reading performance, intelligence, visual and auditory functioning, and emotional and social development were secured at the sixth-grade level by the examiner through standardized tests and individual examinations.

Analysis of the Data

The subjects were classified into three groups of High, Average and Low Achievers according to their general reading performance on the Gates Reading Survey administered at the sixth-grade level. All other data were analyzed as they applied to these three groups. The data were then analyzed as they applied to the boys and girls among the three groups as well as among the total subjects. Differences among the groups or between the sexes were considered to be significant at the 5 per cent level of confidence or if their "t" values were 1.96 or greater.

Major Conclusions

The evidence obtained in this study supports the following conclusions in respect to the subjects investigated:

1. Patterns of reading growth among groups of elementary pupils are established early in the formal reading experience of the group.
2. There is a tendency for individuals to progress in reading in harmony with their mental ability.
3. There is a tendency for favorable characteristics such as mental ability, proper visual and auditory functioning, educational background of parents, and emotional and social maturity to apply to pupils achieving successfully in

reading and for unfavorable traits to describe those pupils achieving less satisfactorily.

4. The educational background of the parents tended to be more related to the reading growth of the groups of pupils than did the occupational status of the parents.

5. Among groups of normal sixth-grade pupils of comparable mental ability the reading performance of the girls tends to be higher than that of the boys.

6. Among pupils at the sixth-grade level there is, in general, little difference between the patterns of reading growth of the sexes within different reading level groups.

254 pages. \$3.30. Mic 57-2010

A TECHNIQUE FOR THE SELECTION OF LABORATORY EXPERIMENTS FOR A COLLEGE GENERAL EDUCATION PHYSICAL SCIENCE COURSE

(Publication No. 20,903)

David Artland Hilton, Ed.D.
Wayne State University, 1957

Adviser: William Reitz

Problem: 1. To evaluate a laboratory program accompanying a college Physical Science course at Wayne State University. 2. To test experimentally a method of selection of laboratory experiments for a Physical Science laboratory program which would provide desirable science-education experiences for the general education of college students.

For the first part 12 experiments were prepared in accordance with 6 criteria for the preparation of experiments for a Physical Science laboratory program. The experiments were used in the Physical Science laboratory sections during both semesters of the 1954-1955 school year. A questionnaire was employed at the end of each semester to obtain student opinion as a basis for evaluation of the laboratory course.

The student questionnaire data indicated:

1. The Physical Science course is a valuable general education science course to them.

2. In terms of student opinion the laboratory is both valuable and helpful in understanding lecture course concepts.

3. The laboratory is a method by which scientific methods may be experienced and scientific attitudes may be inculcated.

4. Laboratory experiments can be scheduled to parallel closely the schedule of lecture presentation.

5. Twelve experiments are sufficient for the semester although more experiments may be used to accompany the lecture course.

6. The two-hour laboratory period is deemed most desirable.

7. Relatively simple equipment can be employed effectively to achieve Physical Science laboratory objectives.

The second part was concerned with an experimental test of a method by which laboratory experiments could be selected. The topical area of heat was used for specific experimentation in a pilot investigation (Spring, 1955) and topical areas of mechanics, heat, electricity, and wave phenomena were used in an expanded investigation a year

later (Spring, 1956). For each area, a group of specialists was requested to rate experiments as to how well those experiments illustrated appropriate science principles. The experiment which was assigned to the greatest number of science principles and which received the highest composite score and the experiment which was assigned to the fewest principles and received the lowest composite score, were used in the investigations.

Two laboratory groups and one non-laboratory group participated in both the pilot and expanded studies. One laboratory group performed the experiment which the specialists rated highest. The other laboratory group performed the experiment which the specialists rated lowest. The non-laboratory group received only the lecture. The two laboratory groups received both lecture and laboratory. All three groups were pre-tested with an examination on the science principles of the respective topical area. The particular science examination was employed as the criterion post-test in each case. The post-tests were adjusted for the total scores on the A. C. E. Psychological Examination (general college aptitude) and for the pre-test scores (initial ability). Analysis of variance-covariance technique was employed after L-Homogeneity tests indicated that the technique was appropriate to the data.

The experiment indicated that the science principles-science specialist method for selecting the most effective experiments for inclusion in a college Physical Science laboratory program was not vindicated by any statistically significant variation. Because the laboratory program does not produce significantly better results as measured by the understanding of science principles, it is doubtful that any method for selecting experiments for Physical Science laboratory could be identified as being better than any other method. The experimental evidence seems to support the conclusion that a Physical Science laboratory program is of little or no value in assisting students in understanding science principles and that student opinion concerning the value of the laboratory is of questionable value.

136 pages. \$2.00. Mic 57-2011

A SURVEY OF SHORT COURSE PROGRAMS IN THE UNITED STATES AND CANADA

(Publication No. 20,212)

Vernon Carl Larson, Ed.D.
Michigan State University, 1955

The purpose of this study was to survey the land-grant institutions of the United States and the agricultural schools and colleges of Canada to seek answers to the following questions: (1) What is the extent of the short course program in the land-grant institutions throughout the United States? (2) What is the extent of the training in Canada which is comparable to the short course programs at the land-grant institutions in the United States? (3) How are such programs organized and administered? (4) How is this type of educational program integrated with the total pattern of agricultural education in the various institutions? (5) What are the characteristics of existing short course programs?

The questionnaire was selected as the survey instrument and in order to delimit the study, a "short course"

was defined as "a non-degree program in agriculture or home economics of four weeks or longer in duration". Thirty land-grant and thirteen Canadian institutions indicated that they had programs which could be classified under this definition.

Entrance requirements varied concerning education, age, and experience. Over eighty percent of the institutions made provision for having short course classes separate from degree classes. Much mention was made concerning instructional techniques. The short course student is more occupied with class activities than is the degree student in most institutions. Less than ten percent of the students transfer to the degree program in over three-fourths of the land-grant colleges and universities.

Several methods and techniques were suggested for orientating the new students. Counseling services for the short course students need to be particularly effective and efficient since the time interval during which the college can assist them is limited. Most institutions preferred small dormitories with two students per room.

A total of eight hundred and nineteen scholarships were available at the land-grant institutions to short course students with a value of over eighty-five thousand dollars. Over thirty types of leadership activities were mentioned as being used to train short course students.

Placement and follow-up activities were provided by twenty-eight percent of the institutions, while placement only was provided by sixty-one percent. The three most helpful groups in assisting with the promotion of the short course program were the extension personnel, instructors of vocational agriculture, and short course alumni. Some of the problems which confronted the short course administrator were: maintaining of sufficient enrollment, channelling of proper publicity to prospects, having a staff that understands the objectives of the course, desirable housing, sufficient scholarships, adequate budget, and a full time director.

The land-grant institutions that offered no short courses of four weeks or longer in duration listed a limited budget and inadequate housing and instructional facilities most frequently as being the reasons for not having a short course program. Fourteen of the thirty-three institutions that were not offering short courses indicated that they were desirous of establishing a short course program.

137 pages. \$2.00. Mic 57-2012

THE TREATMENT OF FOREIGN PEOPLES AND CULTURES IN AMERICAN HIGH-SCHOOL LITERATURE BOOKS

(Publication No. 21,328)

Charles Stephen Lewis, Ph.D.
University of Michigan, 1956

The purpose of this investigation has been to determine the extent of material and the nature of such material dealing with foreign peoples and cultures to be found in American high-school literature books. It was hoped that such a study might result in the improvement of high-school literature books toward a better international understanding.

One hundred thirty-two high-school literature texts

published since 1930 were secured for examination after correspondence with twenty-six publishing companies which had been active in the publication of such textbooks. These textbooks were carefully read and analyzed and the results of the analysis recorded on a form for recording data adopted from one recommended by UNESCO. The study was made in five divisions according to the courses for which the texts were designed: English literature, American literature, English and American literature combined, general literature, and world literature.

The following seven questions were posed and answered.

1. How much material about other nations is to be found in highschool literature books?

In English literature books an average of 11.5 per cent of their contents is devoted to foreign peoples; American literatures average 9.3 per cent; books combining selections from English and American literature devote 17.8 per cent to foreign peoples; general literatures average 22.2 per cent and world literatures 41.7 per cent.

2. What is the materials' distribution?

About 58 per cent was European, with Italy, France, Russia, and Germany leading in that order; the Orient was represented by 18 per cent, most of which was divided between China and India; South American literature comprised 13 per cent; and the remaining 11 per cent was scattered among other parts of the world.

3. Does the material give a true picture of these peoples and their ways of life in a modern day world?

Little delineating modern conditions in foreign lands is to be found in American high-school literature books and that little is representative of only a portion of the globe.

4. Have our literature books kept pace with present conceptions of world citizenship?

The books for the four courses that survived World War II (general literature courses have replaced those combining English and American literature) all advance "ideals of human freedom...world interdependence, and the need for international organization".

5. What is the trend; that is, are these peoples better represented now than before the second world war?

Foreign peoples and cultures are better represented since World War II in general literature and world literature books; they are not better represented in American and English literature books.

6. What proportion of this literature is written by American and English authors about the countries and how much of it is the actual product of foreign writers?

The contribution of foreign authors to English and American literature books has been negligible; foreign authored selections comprise 4.9 per cent of general literature books and 22.7 per cent of world literatures.

7. What recommendations should be made for future editors of highschool literature books?

All materials offensive to foreign peoples should be eliminated; English and American literatures should increase the space allotted to modern writers; general literature and world literature books should increase the number of inclusions dealing with modern times in foreign lands and the amount of material written by foreign authors; the apportionment of such material might be altered the better to fit today's world. Since the democracies are competing with the communists in a cold but vital war

involving the millions of peoples of India, the rest of the Orient, and much of Europe and the Middle East, we should do all we can to promote a better understanding of those foreign peoples by American high-school students. The attitude-influencing power of literature can be utilized as a very potent weapon in our non-military arsenal.

195 pages. \$2.55. Mic 57-2013

**A CASE STUDY OF THE TAOS COUNTY,
NEW MEXICO, COOPERATIVE HEALTH ASSOCIATION**

(Publication No. 20,080)

Morris Harry McMichael, Ed.D.
Michigan State University, 1956

The Taos County, New Mexico, Cooperative Health Association, the first of its kind to be established in a Spanish-American County, was incorporated on June 25, 1942. It was organized to render medical service, including surgical and dental treatment, and any drugs, nursing service or hospitalization incident thereto to the low-income County families. Funds were secured from the Farm Security Administration. On August 25, 1949, the Association was dissolved.

The purposes of this study were twofold:

1. To discover and analyze factors which contributed to failure of the Association.
2. To attempt to ascertain systematically the most desirable sequence of actions necessary to help a minority ethnic group, like the Spanish-Americans of Taos County, achieve changes in health practices.

Three avenues of research were followed:

1. Analysis of reports compiled by the Health Association.
2. Interviews with personnel who were instrumental in organizing and administering the project.
3. Interviews with 200 former members of the Association.

The following conclusions were drawn from the study of the Health Association:

1. The English-speaking and Spanish-speaking people in Taos County held different concepts concerning health.
 2. The Association was based on Anglo-American concepts of medical care and practice.
 3. Proper use was not made of the established clinics.
 4. Funds granted by an outside agency resulted in an artificial stimulus for a cooperative community enterprise.
 5. Insufficient time was spent by the administration to educate the people with the new health program.
 6. A continual education program was not practiced.
 7. There were inadequate communication facilities.
 8. There was not sustained leadership at all times.
 9. There was a wide cultural gap between the Spanish-speaking and English-speaking people concerning factors other than health concepts.
 10. World War II affected the efficiency of the personnel and operation of the Health Association.
 11. Membership fees were not adequate to support the Association after it was established.
 12. The fee basis was not thoroughly planned.
 13. Evaluations were not made at regular intervals.
- In order to benefit from the causes of failure of the

Taos County Cooperative Health Association, the following recommendations are offered:

1. Health practices, facilities, and needs should be surveyed before a health program is started.
 2. Membership should be built carefully.
 3. Leaders should be carefully selected.
 4. All points of view concerning health concepts should be considered carefully in a bi-cultural group.
 5. All aspects of the organization should be thoroughly explained.
 6. The education program should be continuous.
 7. A comprehensive plan and program of procedure should be developed.
 8. The recommended plan should be revised as situations demand.
 9. Available communication media should be utilized adequately.
 10. Control of the organization should remain in the communities involved.
 11. There should be systematic leadership.
 12. Medical personnel should be selected carefully.
 13. Financing should be thoroughly planned.
 14. Evaluations should be made at regular intervals.
 15. Outside activities are needed in conjunction with a health program.
 16. Boundaries of a health association should not necessarily coincide with county lines nor exclude parts of communities.
- 279 pages. \$3.60. Mic 57-2014

**THE READABILITY OF OFFICIAL SEABURY AND
RELATED RESOURCE MATERIAL AS MEASURED
BY THE FLESCH FORMULA: A STUDY OF SOME
EPISCOPAL CHURCH SCHOOL MATERIAL
PUBLISHED PRIOR TO 1956**

(Publication No. 20,040)

Max Milton Pearse Jr., Ed.R.D.
The Hartford Seminary Foundation, 1956

Introduction. Two questions supplied a purpose for the study: (1) How easy to read is The Seabury Series and some of its related resource material? (2) How interesting are these materials? The questions were said to account for a relatively small area within the large field of "communications"; and the delimited concern of the study for official Seabury and related resource materials as available for the 1955-1956 church school year was noticed.

The Flesch readability formula used in the study was briefly introduced and its use justified on six counts: (1) the dependence of the formula upon extended research; (2) Dr. Flesch's realism about its limitations; (3) the wide use of the formula and its consequent evaluation; (4) the failure of any investigator with which the writer became acquainted to dispute successfully the value of the formula; (5) the positive endorsement which some independent investigation has lent to the formula; and (6) use of the tests by important American groups.

The introduction closed with a survey of special problems involved in using the Flesch readability formula chosen for this study. The most important of these was the limitation of the sample size to 15 for most of the books analyzed.

Body. The body of the study was built from a series of readability investigations. These included: (1) adult readers which comprise The Church's Teaching Series; (2) adult study guides for The Church's Teaching Series; (3) parents' and teachers' guides for The Seabury Series; (4) books for young people within The Seabury Series; and (5) Episcopal worship services and hymns as related to The Seabury Series.

A common pattern was generally used for the discussion and analysis of each text considered. It was comprised of: (1) claims made about the readability of a text; (2) the sampling technique used for the particular book; (3) a report of Flesch readability ratings; (4) a discussion of reasons for these ratings; (5) comparative rewriting of some difficult portion.

Conclusion. The study found human interest scores for the twenty books and three worship services considered to be almost completely adequate for their audiences. Three suggestions were made for the further development of interesting texts: (1) the investigation of reading interests of Episcopalians; (2) the use of original source material; (3) more experiment with rewritten versions.

The second conclusion of the study was that difficulty adequacy for the material analyzed was not uniform. Suggestions included: (1) a study of Episcopal laymen's educational backgrounds; (2) study of the impact of social conditions on American readers; (3) a complete testing of materials; (4) a further check on the adequacy of the formula used in this study; (5) experimental rewriting to combine better readability scores with adequate style; (6) comparative studies of graded denominational material; (7) further study of communication problems not accounted for by the formula. Special suggestions dealing with worship text difficulty included: (1) careful attention to punctuation by the officiant at a service; (2) help for children with the vocabularies of worship texts; (3) gradual exposure of children to worship services; (4) graded children's worship as a supplement to family worship; (5) courses for older children on the development of worship texts; and (6) consideration for the needs of all worshippers by revisers.

Finally, it was noticed that there seemed to be a discrepancy between claims made for some texts and the reported ratings from their ease and interest scores. Suggestions were: (1) the adoption of a uniform standard of evaluation; (2) complete testing of material; and (3) printing of formula ratings and grade level estimates in official descriptions of Seabury material.

240 pages. \$3.10. Mic 57-2015

A COMPARATIVE STUDY OF THE COUNSELING METHODS EMPLOYED BY THE GRADUATES OF ANDOVER NEWTON THEOLOGICAL SCHOOL AND EASTERN BAPTIST THEOLOGICAL SEMINARY

(Publication No. 21,350)

George Emil Riday, Ph.D.
University of Michigan, 1956

The purpose of this study was to examine the counseling philosophies and methods of the graduates of two contrasting theological institutions. Andover Newton Theological

School, located at Newton Centre, Massachusetts, was chosen because it offers rather extensive work in counseling which concludes with an experience in clinical practice for a period of twelve weeks. The other, Eastern Baptist Theological Seminar, at Overbrook, Pennsylvania, has no clinical training for its students and offers few courses in counseling or related fields.

Data were gathered on two prepared forms: a Counselor Information Sheet on which the respondent indicated his type of employment, academic background, experience, and number of books on counseling or related subjects read during the past five years; and an Interview Report Form on which the respondent described the client, his problem, what the counselor did about the problem, the attitude of the counselor and client toward each other, whether or not a referral was made, and indicated whether the respondent kept records of such counseling contacts. Those who participated in the study were requested to report interviews that they had during any four week period between October 1 and November 30, 1955.

Eight criteria were selected by which to judge the interviews submitted:

1. Identification of the Real Problem
2. Clarification of the Problem
3. Encouragement of Free Expression of Feelings
4. Absence of Moralizing or Preaching
5. Appropriate Use of the Resources of the Christian Faith
6. Identification of the Client's Need with his Problem
7. Helping the Client to Help Himself
8. The Ability to Recognize the Need for a Referral

In the light of these criteria three persons with training and experience in counseling independently judged 111 interviews (53 from Andover Newton and 58 from Eastern drawn from a sample of half the total number) as "good," "questionable," or "poor." Without knowing the ratings assigned by the three judges, the writer also classified these interviews. The correlation between the average ratings of the three judges and the writer was .74. The Spearman-Brown formula was applied to the "three person" evaluation and that of the writer with a resulting coefficient of .85. Under this procedure the 111 counselors were rated as follows:

	Andover Newton	Eastern
Good	35	8
Questionable	12	18
Poor	6	32
Total	53	58

Two other considerations carried weight in the evaluation of the training afforded in these two institutions: (1) the quality of the reporting of interviews and (2) reasons given for not participating by those who declined to cooperate in this inquiry. Each of these factors indicated revealing information concerning counseling philosophies and methods.

The statistical data show that there is little difference between the graduates of the two schools in the amount of talking during the interview by the counselor and by the

client ($X^2 = 1.87$, not significant), and attitudes of counselor and client toward each other (counselor's attitude toward client - $X^2 = 3.941$, not significant; client's attitude toward counselor - $X^2 = 2.970$, not significant, number of interviews $X^2 = .728$, not significant), and the types and frequencies of the problems confronted (Rank-difference correlation coefficient of .80). Such information leads to the conclusion that regardless of the amount or type of their theological training most ministers, if not by their own choice then by the very needs and insistence of the people to whom they minister, are compelled to be counselors.

When the eight criteria mentioned above were applied to the reported interviews, the evaluations supported the hypothesis that the graduates of Andover Newton Theological School adhere to philosophies and methods of counseling which are more consonant with currently acceptable counseling techniques than do those of Eastern Baptist Theological Seminary. 177 pages. \$2.35. Mic 57-2016

EDUCATION, ADMINISTRATION

THE EXTENT OF NEW PERSONNEL EMPLOYED AND SERVICES PROVIDED IN FOURTH CLASS SCHOOL DISTRICTS IN PENNSYLVANIA FOLLOWING FORMATION OF JOINTURES

(Publication No. 21,000)

Jesse William Cogley, Jr., Ed.D.
University of Pittsburgh, 1957

The purpose of this study is to show the changes in personnel and services in fourth-class school districts in Pennsylvania as a result of joint operation. All fourth-class school districts organized during the period from July 1, 1947, to January 1, 1951, were studied for the year prior to joint operation and the third year after joint operation. The changes in personnel and services were indicated in a number of selected tables and a critical analysis made of the changes.

A check list prepared by the Pennsylvania Cooperative Program in Educational Administration Committee of 27 was sent to all the participating schools requesting them to check each of the items on a graded scale one year prior to joint operation and the third year after reorganization. The replies were tabulated according to the geographical locations of the nine convention districts as established by the Pennsylvania State Education Association. Personnel were divided into the fields of administration and directional, supervisory, health, guidance, instructional, business, and consultant, with tables showing the changes before and after joint operation. In like manner services were divided into the fields of special services, professional employee services, on-call services, administrative services, and extension services.

It was found that the number of districts involved in the 55 jointures covered a range of from two to ten, and the pupil population ranged from 300 to 2800. Forty-seven per cent of the jointures reported less than 1000 pupils, and sixteen per cent more than 1600 pupils.

The greatest changes in personnel were supervising

principal, secondary principal, elementary principal, supervisors of art, music, physical education, school nurse, guidance counselor, librarians, and school clerks. The least number of changes in personnel were directors of audio-visual aids, public relations, dental hygienist, psychologist, deans of boys and girls, social worker, department heads, and business manager.

Services showed the greatest number of changes in driver training, audio-visual equipment, homebound instruction, legal advice and services, medical service, centralized purchasing, school lunch program, and adult education classes. The least number of changes were classes for the mentally gifted, hard of hearing, uneducable but trainable, sight saving, remedial, student council, bookmobile, reading consultant, speech correctionist, surveys, transportation coordinator, child guidance, research, and vocational classes for out-of-school youth.

It was concluded that over a period of three years progress was made in both personnel and services, by the 239 school districts which united in forming 55 joint operations of schools.

To see if the size of the school district had any influence on the progress made, the 55 replies were also classified in five pupil population areas, ranging from less than 500 to more than 2000. The rating scale for three years after joint operation was used, showing the median school district in each pupil population area. The results indicated that size is not an influencing factor.

The check list, presented by the Pennsylvania Cooperative Program in Educational Administration Committee of 27, indicates the advanced thinking of men dedicated to the purpose of providing better education and services to the boys and girls of Pennsylvania.

The evidence indicates that it would be impossible for jointures, with the pupil population shown in this study, to provide all of the personnel and services on the check list. The intermediate service unit proposed by current legislation would be of considerable help in these highly specialized fields.

There is a need for many of these jointures with small pupil population (26 under 1000) to reorganize with adjacent districts to form larger administrative units.

Progress has been made towards the equalizing of educational opportunities for all the children in Pennsylvania. 195 pages. \$2.55. Mic 57-2017

A STUDY OF THE EXPECTANCIES WHICH ELEMENTARY TEACHERS, SCHOOL ADMINISTRATORS, BOARD MEMBERS AND PARENTS HAVE OF THE ELEMENTARY TEACHERS' ROLES

(Publication No. 21,053)

Louis Andrew Doyle, Ed.D.
Michigan State University, 1956

Statement of the Problem

The purpose of this study was to identify the role expectations which elementary teachers, public school administrators, school board members and parents have of the elementary teachers' roles; the role expectations which teachers believe these groups hold, and to compare

these expectancies, noting the convergence and divergence of the role expectations held.

Procedure

Elementary teachers, school administrators, school board members and parents in three communities were interviewed, using a check-list involving forty-eight specific acts dealing with six selected teacher professional roles. Teachers were asked to indicate their own beliefs regarding the action, their definition of the administrators' expectations, their definition of the school boards' expectations and their definition of the parents' expectations regarding the action. Administrators, school board members and parents were asked to define their own beliefs or expectations regarding the actions.

Findings

The teachers involved in the study appeared to be oriented toward the traditional aspects of their calling, to conform to the patterns which the culture has defined for them. In the analysis of the findings of the study it was noted that, as the beliefs of the teachers and the expectations which they defined for the others were compared, that the teachers were inclined to see themselves as being in harmony primarily with the administrators, to a lesser degree with the school board members, and to a limited degree with the parents.

It was found by use of Chi-Square that there appears to be little relationship between the age of teachers, years of teaching experience, number of school systems in which taught, expected number of years of future teaching, and the beliefs held by them or the expectations they defined for the others.

The teachers in the study tended to define their professional roles in a much narrower way than did the administrators, school board members, and parents. While the teachers defined their own professional roles in a broad perspective, they did not attribute to the others the same views that they held.

Administrators, school board members, and parents were inclined to view the roles of the teacher from a liberal point of view. They appeared willing for the teachers to operate in broader and more dynamic ways.

Recommendations

Certain recommendations which arise out of the study and which are based largely on the problem of helping teachers to build a clearer self-image, as well as to modify the public image of the teacher, are:

1. Teachers should be encouraged to interact with a wide variety of community organizations and individuals.
2. Use should be made of teachers in the conduct of community surveys, taking of the school census, opinion surveys, and such other appropriate activities as will bring the teachers into wide contact with lay citizens.
3. Community groups should be encouraged to sponsor various types of programs designed to emphasize the human side of teachers, and to stress their individual achievements.
4. Teachers should be invited or otherwise encouraged to appear at meetings of the board of education to discuss their programs, problems and needs. They should be

called upon to act as consultants to the school board when problems which lie in their area of competency are being studied.

5. In-service training programs in the area of school-community relationship should be developed for the school systems, with teachers involved in the planning of such programs. 195 pages. \$2.55. Mic 57-2018

AN ANALYSIS OF THE ATTITUDES OF TEACHERS AND ADMINISTRATORS ON THE SCREENING-TESTING PHASE OF THE SCHOOL HEALTH PROGRAM IN THE ELEMENTARY SCHOOLS OF DETROIT

(Publication No. 20,905)

Theodore Mandell, Ed.D.
Wayne State University, 1957

Adviser: W. Ray Smittle

PURPOSE OF THE STUDY:

Health services in schools are designed to promote and maintain good health in children. "Every phase of a child's training and development is conditioned by the state of his health." One activity of a typical health services program is the applying of screening tests to children by teachers in order to discover signs of health problems, and the proper recording of these symptoms so that effective follow-through may ensue. The classroom teacher in Detroit is the key person in this step in health services. It is he who, near the beginning of each school year, inspects every child in his room, records whatever signs of health problems he sees and reports his observations to the nurse or to the principal's office. This Study attempts to discover the attitudes of teachers toward this responsibility. It attempts to ascertain the attitudes of teachers and administrators regarding their training and fitness to effectively carry out and supervise the screening tests. It also seeks to determine the extent of the teachers' and administrators' involvement in the follow-through procedures in the health services phase.

DESIGN OF THE STUDY:

A questionnaire was sent to a random sample of teachers in the elementary schools of Detroit, which sought to determine attitudes of teachers toward 1) the various steps in giving screening tests, 2) their adequacy and preparation for such a responsibility, 3) their involvement in follow-through, and 4) their relationships with the school nurse. A separate questionnaire was sent to a random sample of elementary school principals and assistant principals which sought to determine their attitudes on 1) the adequacy and preparation of teachers to administer screening tests, 2) their own adequacy to supervise this phase of health services, their involvement in follow-through, 3) their attitude toward the importance of screening, and 4) their relationships with the school nurse. An analysis of the returned questionnaires was made. Statistical tabulation graphically presented the responses to each question. Certain correlations were made such as whether there was any difference between men and women teachers in their attitudes on selected items, or whether the number of years of teaching or administrative experience

caused any difference in attitudes toward certain phases of the screening program.

A review of the literature was included, covering 1) an overview of school health programs, 2) contents and scope of health services in schools, and 3) the roles of the teacher and administrator in health services. Brief descriptions of health services in the schools of Chicago, Los Angeles, New York, Philadelphia and St. Louis were included. The major differences between these cities and Detroit were outlined.

MAJOR CONCLUSIONS:

Eighty-three per cent of the teachers and 76 per cent of the administrators returned their questionnaires. The majority of teachers felt that they were inadequately trained to conduct the screening tests effectively. They felt that these tests ought to be given by more qualified personnel. Half of the administrators thought that the teachers were inadequately prepared to screen effectively and three-fourths of them felt that inservice training in this area was invaluable. Statistical tabulation of the results demonstrated that both teachers and administrators are but little involved in follow-through procedures. The results indicated that there is need for improvement in the areas of communication between teacher and nurse and between nurse and administrator.

296 pages. \$3.80. Mic 57-2019

A STUDY OF INTERPERSONAL INFLUENCE WITHIN A SCHOOL STAFF: THE DEVELOPMENT AND TRIAL OF A METHOD OF ANALYZING INFLUENCE WITHIN ESTABLISHED NETWORKS OF COMMUNICATION

(Publication No. 20,876)

Lloyd Everaldo McCleary, Ed.D.
University of Illinois, 1957

This investigation attempts to apply to the study of a school the concepts of organization theory which treat organization as social structure. The concern of the study is with the structures and processes of interpersonal influence which operate within a school professional staff. Methods were adapted and devised which permitted the description and the examination of the interrelationships of the members of a school staff relative to the problem of interpersonal influence.

The regular work-oriented contacts of school staff members were judged to be the important media for the exercise of person-to-person influence. The plan of the study embodied two phases. First, the regular person-to-person contacts of the members of the school staff were identified and described in terms of the networks of interrelationships which they created. Second, the personal relationships identified in the first phase of the study were examined as they were used by the staff in the exercise of interpersonal influence. Data from observation and interviews related the findings of the contact communication structure and the influence structure to operational activities of the staff.

The first phase of the investigation was based upon the following principal assumptions: 1) that the structure of the organization of a school staff could be described through

an examination of the total system of regular work-oriented interrelationships of staff members, 2) that these regular person-to-person contacts served as the communication structure for the members of the staff as they developed attitudes and opinions relative to school affairs, and 3) that staff members themselves could identify these relationships. A sociometric type instrument was designed which permitted the identification of the regular validated contacts of pairs of individuals and the patterns of contact among sub-groups due to inter-individual contacts. The structure of the organization was revealed through the use of established procedures of matrix analysis and directed graph theory. The responses of the staff indicated a considerable degree of agreement among members concerning those with whom school affairs were regularly discussed, and data collected with reference to specific school issues indicated that the established channels of communications would very likely be those regularly used to discuss school affairs.

In the second phase of the study interpersonal influence was examined within the structure of validated networks of personal relationships. The influentials within the structure were identified on the basis of measures of domain, weight and sphere of influence. The members of the staff were classified by these measures as high, medium or low influentials. The flow of influence within the structure was then examined.

The adaptations of techniques from related fields which were employed in this study proved workable. The study served as a try-out of a method derived from research outside of the field of education and it should contribute to the further development of research which has general applications to the study of social units.

The study has demonstrated that the interpersonal relationships of staff members affect the functional operation of the school in many important ways, and it has provided a method by which these relationships can be examined. The study of the influence process seems particularly crucial to school administration but it has received little attention in the past. The approach employed in this investigation proved sound and, along with the development of a more comprehensive device for the identification of influentials, should contribute to further study of the structures and processes of interpersonal influence within school staffs.

125 pages. \$2.00. Mic 57-2020

THE FUNCTION, ORGANIZATION, AND OPERATION OF THE COUNTY SCHOOL DISTRICT IN OHIO

(Publication No. 21,495)

John Shaw Rinehart, Ph.D.
The Ohio State University, 1957

Like many other states, Ohio is searching for means to improve its public school system. The Ohio legislature was motivated by the same worthy objective when it re-created the county school district in 1914. The county school district, or the intermediate unit of school administration, was re-established to improve certain aspects of rural education. However, there are those who believe that the county unit has not altered in any fundamental way since its inception, that it has not kept abreast with the

changing needs of education, and that it should be either reorganized or abandoned. Any suggested action of this nature requires objective data for its basis.

In line with this viewpoint, the present study was initiated to procure dependable information concerning the county school district in Ohio--its origin, development, function, organization, operation, and status. Not only the present role, but the possible future role, of the intermediate unit was made a concern of the study.

The interview method was adopted as the most reliable means of obtaining data reflective of both the structural arrangements and the day-to-day working relationships between county and local school districts. Stress upon attitudes, feelings, values, and concerns of people involved in communities affected by the county school district required that a comprehensive rather than a general study be conducted. Accordingly, procedures were adopted to select six representative counties for this phase of the study.

Personal interviews were scheduled with many people in each of the six counties selected. With the help of an interview-guide, the county superintendent, county board members, county auditor, county treasurer, county prosecutor, county juvenile judge, county bank president, county newspaper editor, county Farm Bureau Chairman, county health director, the agricultural agent, and other lay people were asked to give their candid reaction to and evaluation of many aspects of the local county school district arrangement. The data thus accumulated were later supplemented by a questionnaire study conducted in the remaining counties, eighty-two in all.

In general, the structure and organization of the county school district were found to be ambiguous and ineffective. Few, if any, of the participants understood the purpose of the intermediate unit. Partially because of this factor and partially because of the quality of leadership, the potential services of the intermediate unit had not been properly identified or allocated. Misunderstanding, confusion, and conflict more often than not permeated the working relationships between county and local school districts, there being little evidence of coöperative interaction in planning and decision-making.

Study recommendations call for a more functional intermediate unit in Ohio--a new type of unit based upon the concept of service and involving the active participation of those affected. Major stress is given the leadership-consultant-service-research role of the intermediate unit. All operating school districts are given the privilege of utilizing intermediate services to improve the scope and quality of their educational programs, but the operation of the schools and the power of decision remain with the local boards of education. Thus legal coördination between the intermediate level and the local level is urged as a means of assuring the responsiveness of the intermediate unit to the needs and desires of the people and of encouraging the continuous growth and development of a democratic school system.

477 pages. \$6.10. Mic 57-2021

AN EVALUATIVE STUDY OF A DEVELOPMENTAL ELEMENTARY SCHOOL PROGRAM

(Publication No. 20,910)

Edith Roach Snyder, Ed.D.
Wayne State University, 1957

Adviser: Ole Sand

This dissertation has three purposes: (1) to share with others the story of a developmental elementary school program; (2) to describe the changes in curriculum; and (3) to evaluate the effectiveness of the program.

The story reports an educational plan in action which was designed by children, parents and teachers as a way to improved learning and living of children. It probes deeply into the activities of a particular school.

Characteristics of the program are described as changes were made in curriculum and school organization to facilitate the implementation of the program.

Questionnaires filled in by children, parents and teachers, interviews with parents and cumulative records at the junior high level, provided data to evaluate the effectiveness of the program. Four broad problem areas were examined:

1. The reaction of the children to current school procedure, their feelings about their own achievement, their evaluation of the instructional program and their suggestion for improvement of their school.
2. The responses of parents related to their appraisal of school climate, their participation in the school, their evaluation of the present program and suggestions for other educational experiences for children.
3. The teachers' appraisal of current practices and their recommendations for further consideration.
4. Subsequent achievement of Webster School students and others.

The main conclusions obtained from the evaluation were:

1. Children like their school. They are happy there. They like their friends and they like their teachers. Most children want to stay with their group and their teacher over longer periods of time than a semester or a year. Most children expressed the feeling that they are doing their best and think they know how well they are doing. They are enthusiastic about the participation of their parents in school activities. They want their parents to come to school. They like conferences.
2. It appears from parents' responses that they sincerely endorse the existing school program. They enthusiastically accept the organization of the school which provides opportunities for children, parents and teachers to work closely together over long periods of time, which in turn, makes possible a better understanding of each child, his problems and his needs. Parents favor the parent-teacher and parent-teacher-child conferences as a means of reporting their child's growth and development. Parents were pleased to have their children live in a happy, busy climate and were especially grateful for their children's healthy attitudes about school. Parents praised the instructional program; they like the broad curriculum.
3. Teachers expressed appreciation of the kind of environment in which they live and work. They recognized the professional and friendly attitudes of their colleagues. They reacted favorably to the school where they can creatively plan a program with children and parents which is

designed to meet the needs and interests of the children in their room. Teachers liked the organization of the school for it makes possible a program of continuous learning for children. It encourages long term planning. Teachers appreciated the fine attitude and generous help of parents.

4. Interest was declared in the subsequent achievement of boys and girls who graduated from the elementary school which is being evaluated in this study. It was believed that greater educational competencies would come when educational experiences were improved. There is evidence to substantiate this belief through the achievement records and the citizenship ratings of the students in seventh, eighth and ninth grades.

This evaluative study of a developmental elementary school program presents evidence that there are kinds of educational experiences, qualities of human relations and factors in the environment of a school community that promote optimum growth of children.

158 pages. \$2.10. Mic 57-2022

IDENTIFICATION OF TROUBLESOME PROBLEMS AFFECTING ST. PETERSBURG JUNIOR COLLEGE STUDENTS, WITH IMPLICATIONS FOR GUIDANCE PROGRAM IMPROVEMENT

(Publication No. 20,745)

Donald James Tolle, Ed.D.
The Florida State University, 1957

The major purpose of the study was to collect and analyze data which would serve as a basis for guidance program improvement at the subject junior college. To achieve its aim, the study was designed to provide information of the following kinds:

1. identification of the troublesome problems of St. Petersburg Junior College students;
2. student and faculty opinion regarding college responsibility to provide an extensive guidance program;
3. student and faculty opinion as to extent of student aid actually provided by the current St. Petersburg Junior College program;
4. student and faculty suggestions for improvement of the guidance program;
5. extent to which the actual guidance program and the stated guidance philosophy of the subject junior college are consistent with each other;
6. implications of the survey findings for improving the subject guidance program.

The survey instruments used to gather data for the study were the 1950 revision of the Mooney Problem Check List (College Form) and a questionnaire devised by the writer. A total of 519 students and 24 faculty members participated in the survey.

Statistical tests were run to determine if there were significant differences on the Mooney Problem Check List response between problem frequency means of various

sub-groupings within the total student sample. These test results provided a basis for intensively comparing certain of these groups as to response to the items on the Mooney. The student groups thus compared were as follows: (1) female and male; (2) younger (twenty years of age and below) and older (twenty-one and above).

Response to the three parts of the questionnaire was reported for the total student group and for the total faculty participants.

Following are certain results and conclusions which accrued from the study:

1. The student survey group reported an average of 34.7 problems per person, a slightly higher mean than found by several other studies using the Mooney Problem Check List.
2. Problems in the Adjustment to College Work area were of much more concern to the students than problems in any other area.
3. Female students and younger students were found to report a significantly higher mean number of problems than male students and older students, respectively.
4. Many students who indicated that they would like to talk over problems with someone on the college staff did not know where to go for such help.
5. Faculty members tended to evaluate the effectiveness of the guidance program somewhat higher than did the students.

Certain of the recommendations arising from the study were as follows:

1. The St. Petersburg Junior College Guidance Committee should provide leadership in working out the means whereby some of the chief problems of students can be approached through group guidance, both in special guidance groups and in regular classroom situations.
2. Considerable attention needs to be given administratively to the need for expanded personnel services at the subject junior college, including a larger guidance staff and the addition of a vocational guidance office.
3. Certain curricular changes are needed, including an expansion of the Reading Techniques program, the addition of an elective Orientation course, and a rethinking of the role that Health, Physical Education, Sociology, and Psychology classes should play in aiding students to cope with their problems.
4. The Mooney Problem Check List should be made available as a basic instrument in the general guidance program at St. Petersburg Junior College.
5. A study similar to the present one should be carried out in modified form by the Guidance Committee at periodic intervals as a means of pinpointing needed adjustments in the guidance program.

228 pages. \$2.95. Mic 57-2023

EDUCATION, ADULT

A METHOD FOR STUDYING HOW PEOPLE PERCEIVE
THE POWER STRUCTURE IN THEIR COMMUNITIES
AS TESTED IN FIVE MICHIGAN COMMUNITIES

(Publication No. 21,158)

Blue Allan Carstenson, Ed.D.
University of Michigan, 1956

The purpose of this investigation was to develop an efficient, dependable method of studying how people perceive the power structure in their communities. "Power" is said to be possessed by those who are perceived to be the most active and successful in getting things done on community problems. "Power structure" is defined as the hierarchical order of individuals, groups, organizations, and agencies which interact to solve community problems. The method was tested in five small cities in southern Michigan ranging from 7,500 to 25,000 in population and roughly representative of five different kinds of communities. The data gathered were analyzed within the context of other kinds of data about these communities to gain insight into community power structures.

The basic approach of the method was to find those who nominate each other as high power, as many previous research studies have shown that those of high power know who the others of high power are better than anyone else. In this study as a starting point for locating those of high power, certain community officials (the mayor, school superintendent, city manager, librarian, newspaper editor, and community chest executive secretary) were interviewed. By interviewing those named as high power by the community officials, a power list was developed. All new persons or groups whose names appeared on the list were interviewed (and the results of their interviews added to the list), until no new names appeared on the list. The result was a list of those who nominated each other as being powerful, which was considered to be the perceived community power structure. Several alternative methods were also developed.

Some of the insights gained about the five communities where the method was tested are:

1. The perceived power structures varied greatly from community to community.
2. Groups, more often than individuals, are perceived as being among those of highest power.
3. Service clubs were consistently seen as among those of highest power, were rarely seen as sources of information, but were in fact consistently good information sources about power.
4. Mayors and school superintendents were consistently perceived as having the highest power, as individuals, and were among the best information sources about the power structure.
5. Men outnumbered women in the power structure.
6. The older communities have a greater degree of agreement about their power structure than do the newer ones.
7. The PTA was usually perceived as somewhat powerful, but the newspaper, newspaper editors, unions,

and librarians were rarely seen as powerful and were generally poor information sources about power.

In two communities which were studied more intensively, it was found that there had been a major shift in the power structures during the last ten to fifteen years from the control of a relatively few conservative leaders to a much larger group of progressive businessmen.

Several efficient methods of studying the way people perceive power were developed, and some insights have been gained into the way people perceive the power structures in their community. 227 pages. \$2.95. Mic 57-2024

EDUCATION, PHYSICAL

THE DEVELOPMENT AND APPLICATION OF
CRITERIA FOR EVALUATING GUIDANCE SERVICES
IN COLLEGE DEPARTMENTS OF
PHYSICAL EDUCATION

(Publication No. 21,345)

Harold Woodrow Paulsen, Ph.D.
University of Michigan, 1956

The primary purpose of this study has been twofold in nature. First, to determine criteria for accurately evaluating guidance services in college departments of physical education. Secondly, to determine the extent to which certain guidance services are performed by physical education departments in selected colleges and universities.

Method of Attacking the Problem: The procedures used in this study were as follows:

1. A bibliography was compiled of research studies, books, and reports which seem logically related to any and all phases of guidance services in physical education departments of institutions of higher learning.
2. The literature was examined by the writer in order to compile a comprehensive list of guidance services which might prove essential to a good guidance program in a physical education department. These services were restated as potential criteria.
3. The list of guidance practices compiled by the writer was sent to selected physical education leaders to obtain additional practices which may not have been included.
4. The various criteria were organized into six categories:
 - a. Organization and Administration
 - b. Individual Inventory Services
 - c. Information Service
 - d. Counseling Service
 - e. Placement Service
 - f. Follow-up Service
5. A comprehensive list of guidance services was sent to a jury of experts for evaluation. A special set of instructions accompanied the list to facilitate the evaluation of the guidance service by the jury of experts. The jury evaluated the criteria on a scale from 0 to 10.
6. The results of the jury evaluations of the guidance

services were tabulated and analyzed. The mean ratings of the jury's responses to such criterion were determined.

7. The guidance services which were considered to be Extremely Desirable, Very Desirable, or Desirable by the jury of experts were used in construction of the score card for evaluation of guidance services in physical education departments in institutions of higher learning.

8. The guidance score card was tried out in two selected universities. The guidance committees in the Physical Education Department in these two universities used the score card to evaluate the extent to which desirable guidance services were being practiced at their respective institutions.

9. A questionnaire was prepared using the criteria developed for the score card. The purpose of the questionnaire was to obtain information concerning the extent to which desirable guidance services were being practiced, 1954-55, in departments of physical education of selected colleges and universities.

Findings of the Investigation: The findings of the investigation are as follows:

1. Ninety-two criteria were formulated for the evaluation of guidance services in college departments of physical education.

2. A selected jury of experts considered 62 criteria Extremely Desirable, 29 criteria Very Desirable, and one criterion Desirable for evaluating the guidance services in departments of physical education of colleges and universities.

3. A score card and the questionnaire using the 92 criteria functioned as intended in evaluating the guidance services.

4. Fifty per cent or more of the 76 participating departments of physical education of the colleges and universities Practiced 59 guidance services all the time.

5. Fifty per cent or more of the 76 participating departments of physical education of the colleges and universities Never Practiced only six of the guidance services.

Conclusions: The conclusions based upon the findings of the investigations are as follows:

1. The criteria developed and applied in this study may be used to evaluate guidance services in departments of physical education in colleges and universities.

2. The majority of the participating departments of physical education of selected colleges and universities practice the majority of the guidance services most of the time.

130 pages. \$2.00. Mic 57-2025

A COMPARISON OF THE EFFECTS OF FREE AND RESTRICTED EXERCISE ON THE APPEARANCE OF A TUMOR AND THE LONGEVITY OF THE HOST

(Publication No. 21,351)

Dennis Rigan, Ed.D.
University of Michigan, 1956

The purpose of this study is to determine whether exercise affects the incidence and growth of tumors in a mammary-tumor-bearing strain of mice. Under this statement of the problem are four hypotheses. These are:

(1) that exercise may affect the incidence of tumors; (2) that exercise may affect the date of tumor onset; (3) that exercise may affect the growth of tumors after the initial onset; (4) that exercise may affect the length of life of the mice.

The experimental group consisted of thirty-seven mice which were placed in individual numbered exercise cages. The control group consisted of thirty-eight mice which were placed in small individual numbered cages which restricted activity. All the mice were obtained from the Jackson Memorial Laboratory, Bar Harbor, Maine, and were thirty-six days old when received. In the past, this strain has yielded 95 percent mammary-tumor bearers with a mean period for appearance of tumor at nine months, and a mean length of life of three-hundred days.

Environmental conditions for both groups were the same throughout the study except for the amount of activity. Daily recordings of the amount of activity were taken. Food was given in pellet form and was controlled so that the body weight of all the mice was maintained at between twenty-one and twenty-three grams. All the animals were weighed and examined regularly for tumor development.

The study was continued from the time the mice were first received until all the animals were dead. At death the tumors were examined in the Pathology Department of the University of Michigan by Dr. A. James French.

The results of the study are summarized in the following two tables.

TABLE 1
COMPARISON OF EXPERIMENTAL
AND CONTROL GROUPS

Comparison Factors	Experimental Group	Control Group	<u>t</u>	<u>p</u>
Tumor incidence	32	29	2.46	.20 / .30
Date of tumor onset (days)	Mean 355	Mean 320	1.69	.05 / .10
Length of life after tumor onset (days)	Mean 78	Mean 60	2.82	.01
Length of life (days)	Mean 433	Mean 380	2.46	.01 / .02

Five general conclusions can be drawn from the study. (1) There is no significant difference in the incidence of tumors between the experimental and control groups. (2) There is no significant difference between the experimental and control groups regarding the date of tumor onset. (3) There is a significant difference in the length of life after tumor onset between the experimental and control groups, favoring the animals that exercised. (4) There is a significant difference in the length of life of mice in the experimental and control groups, favoring the animals that exercised. (5) Exercise is a factor in determining the

TABLE 2

THE RELATIONSHIP BETWEEN THE AMOUNT OF
ACTIVITY AND TUMOR GENESIS, TUMOR GROWTH,
AND LIFE SPAN

Variables	r	Lower 5% Confidence Limits	Upper 5% Confidence Limits
Revolutions vs. days before tumor onset	.50	.18	.72
Revolutions vs. days after tumor onset	.67	.42	.82
Revolutions vs. total days lived	.43	.09	.67

differences obtained within the experimental group of mice regarding the date of tumor onset, length of life after tumor onset, and the length of life.

In summary, it can be said that the mice which exercised, sustained their tumors longer, and lived longer than did the mice that did not exercise.

99 pages. \$2.00. Mic 57-2026

A COMPARISON OF THE RESULTS OBTAINED BY
THE MITCHELL AND KUDER INTEREST MEASURES
WHEN ADMINISTERED TO MALE FRESHMEN
AT THE UNIVERSITY OF MICHIGAN

(Publication No. 21,379)

Rico Nicholas Zenti, Ed.D.
University of Michigan, 1956

The purpose of this study was to determine the extent to which the results secured by the Mitchell Recreational Interest Study were similar to the results secured by the Kuder Preference Record. An abbreviated instrument capable of determining the compatibility of the interests of college freshmen with the fields of study they pursue would enjoy extensive use by counselors, and would provide reciprocal benefits to both the pupils and the educational institution.

A random sample of 480 cases was selected from a total of 1267 male freshmen who entered the University of Michigan in the fall of 1953. The common basis for comparison was that both tests derived scores, as well as a rank order of preference, for the nine areas of perceivable common elements being compared. Inasmuch as the highest areas of interest indicated by an interest measure are considered as most significant, only the first three choices designated for each pupil by the Mitchell check-list were compared to the first three choices obtained by that pupil on the Kuder Preference Record. Further, the first three choices derived by each instrument were compared to the stated choice of the testee.

The ten areas of the Kuder Preference Record were reduced to nine by virtue of combining the Computational and the Clerical into a single area called Computational-

Clerical. The fourteen areas of the Mitchell Recreational Interest Study were reduced to nine by combining Medicine, Dentistry, and Pharmacy with Science, Journalism with Literary, and Physical Education with Education. This procedure resulted in the following pairing of interest areas for comparison: (1) Literary-Literary, (2) Music-Musical, (3) Science-Scientific, (4) Engineering-Mechanical, (5) Law-Persuasive, (6) Forestry-Outdoor, (7) Education-Social Service, (8) Architecture-Artistic, (9) Business Administration-(Computational-Clerical). A synthesis of six interest studies, appearing in Super's *Appraising Vocational Fitness*, was utilized by the author of this dissertation to substantiate the above arrangement of areas for comparison.

In the first comparison, that of comparing the results secured by the Mitchell Recreational Interest Study with those of the Kuder Preference Record, two scoring techniques were employed. Method I A consisted of assigning a weighted value for the amount of agreement within the first three places. Method I B simply assigned a tally for agreement if the compatible items occurred as first, second, or third choices on both inventories. Both scoring techniques obtained similar results. The greatest amount of agreement was obtained in the interest areas of Science, Persuasive, Outdoor, Social Service, and Mechanical. Lesser agreement was secured in the interest areas of Literary, Musical, Artistic, and Computational-Clerical.

In the second comparison, that of comparing the results obtained by each of the two tests to the stated choice, a weighted scoring system was employed in Method II A, while a tally scoring system was utilized in Method II B. The results of comparing by Methods II A and II B showed the Mitchell Recreational Interest Study to secure the greatest agreement to stated choice in the interest areas of Law, Science, Education, Forestry, Music, Engineering, Literary, Architecture, and Business Administration, in the order given. The Kuder Preference Record secures the greatest amount of agreement to stated choice in the following order: Musical, Artistic, Scientific, Computational-Clerical, Persuasive, Outdoor, Social Service, Literary, and Mechanical.

The general conclusion that may be drawn from this study is that while each interest measure secures a definite assessment of interests, the amount of agreement indicated by the two main comparisons does not warrant an interchangeable use of these interest measures at the present time.

122 pages. \$2.00. Mic 57-2027

EDUCATION, PSYCHOLOGY

EVALUATION OF DESIRABLE CHARACTERISTICS OF
INDUSTRIAL SUPERVISION AS REPORTED BY
1,899 HOURLY-CLASSIFIED WORKERS

(Publication No. 21,179)

Walter Stanton Grimala, Ph.D.
University of Michigan, 1956

This is a study of the desirable characteristics of industrial supervision as perceived by a sample of the

hourly-classified employees who participated in "My Job Contest" conducted by the General Motors Corporation. Original letters submitted by these participants provided the basic data for this inquiry. Although many "themes" are mentioned in these letters, this study deals only with supervision.

The qualitative treatment of the supervisory theme involved analyzing letters for supervisory content, classifying and coding references to supervision, and then arranging these references into meaningful categories. The quantitative treatment of the foregoing information employed standard statistical treatment of its relation to such variables as the sex of the workers, their occupational status, and their levels of skill, upon the supposition that significant relationships would not only be discovered but that significant differences among them would also be found.

Through subjective, qualitative analysis it was found that the workers in question had judged the supervisor as a person as well as his supervisory methods and demeanor. As a person, he should be cooperative and helpful, considerate and kind, understanding and sympathetic, fair and just, pleasant and congenial; his methods and behavior should be typical of those which characterize good personnel management and good human relations. "Job competence" was emphasized least of all.

Although the rules of "My Job Contest" limited the participants to a discussion of what they liked about their work, the investigator was able to infer from the workers' responses many objectionable supervisory behaviors and methods, as well as the effects of desirable supervisory characteristics upon the attitudes of the workers toward their jobs and toward their supervisors.

Through statistical analysis it was found that:

1. The following differences were identified with the sex of the workers:

Male workers placed more emphasis on job competence in supervision than did female workers.

Desirable methods of supervision affected the attitudes of male workers more strongly than those of the female workers.

Female workers, more strongly than the male workers, emphasized desirable personality characteristics as essential to good supervision.

2. The following differences were identified with the levels of skill of the workers:

The unskilled workers emphasized the importance of supervisory behavior and methods on the job.

The semi-skilled workers emphasized the importance of supervisor-employee relationships.

The skilled workers emphasized technical competence at the supervisory level and indicated that their attitudes toward their work varied directly with the desirable or the undesirable characteristics of the supervision they received.

Finally, it may be stated that the opinions of the hourly-rated workers deviate from those generally attributed to management in regard to the characteristics of effective, or desirable, supervision. In the aggregate the former want supervisors to be employee-oriented and socially-minded individuals, who can de-emphasize their own personal needs and dedicate themselves to the service of the

employees whom they supervise; in short, who manifest good human relations in the discharge of their responsibilities. By so doing, these managerial agents, so the workers believe, will safeguard the equities of both the employer and the employee.

215 pages. \$2.80. Mic 57-2028

THE FORMULATION OF A SCALE TO EVALUATE THE CONCERN OF HIGH SCHOOL BOYS FOR THE SOLUTION OF THE DEVELOPMENTAL TASKS APPROPRIATE TO ADOLESCENCE

(Publication No. 20,992)

Robert Lee McCleery, Ed.D.

The University of Nebraska Teachers College, 1957

Adviser: D. A. Worcester, Ph.D.

The Problem

The author of this study recognized the increasing acceptance of the developmental task concept as a useful way of expressing the motivation of adolescents, and has attempted to develop a scale to evaluate the concern of adolescent boys for the solution of the developmental tasks appropriate to that level of development.

The Procedure

The author first selected a list of the developmental tasks of adolescence which seemed to represent the latest and most widely accepted thinking on the subject.

Next, a preliminary test was developed which contained seventeen items related to each of the task areas. This test was administered to 235 randomly selected high school boys at Scottsbluff, Nebraska. The number of items which significantly differentiated between the seniors and freshmen in the group was determined. The results of this procedure indicated that either the test was not of sufficient validity or that grade level, by itself, was not an adequate criterion of maturity.

To test the latter hypothesis, the instrument was administered to a new group of seventy-one senior boys who were defined as mature.

1. All were seventeen or eighteen years of age.
2. All had been elected by their peers to attend the 1953 National Hi-Y Congress at Miami University, Oxford, Ohio and had traveled to this Congress from distant parts of the United States.
3. All were elected officers of some organization in their school.

A statistical analysis of the tested relationships between this Hi-Y group and the Scottsbluff, Nebraska freshman group was made.

Findings and Conclusions

An analysis of the test results comparing "mature" senior, i.e. twelfth grade, and a random sample of freshman, ninth grade boys showed that:

1. Of the 170 items in the original test, 150 differentiated significantly between the two groups. These were used to make the final form.
2. Each of the items on the test referred to one of the ten sub-tests pertaining to the ten developmental tasks of adolescence. The number of items pertaining to each varied from eleven to seventeen.
3. On the 150 item test:
 - a. An adequate degree of test and sub-test reliability was demonstrated.
 - b. Significant differences between the mean scores of the "mature" and freshman groups on each of the ten sub-tests were found.
 - c. Useful information concerning the interrelationships of the sub-tests was discovered, the most significant of which included:
 1. Those sub-tests correlating below .5 include:
Peer Relations -- Social Role
Peer Relations -- Total Test
Physique Acceptance -- Independence of Adults
Physique Acceptance -- Civic Competence
 2. Those sub-tests correlating above .8 include:
Peer Relations -- Social Responsibility
Social Role -- Total Test
Independence of Adults -- Total Test
Economic Independence -- Total Test
Occupational Preparation -- Total Test
Occupational Preparation -- Civic Competence
Family Life -- Total Test
Social Responsibility -- Ethical System
Social Responsibility -- Total Test
Ethical System -- Total Test
 3. Of all the sub-tests those which showed the greatest over-all correlation with all the other tests were Social Responsibility, Ethical System, Occupational Preparation, and Family Life, in that order.

127 pages. \$2.00. Mic 57-2029

THE SUSCEPTIBILITY TO DISTORTION OF THE MINNESOTA TEACHER ATTITUDE INVENTORY

(Publication No. 21,347)

Monroe Samuel Price, Ph.D.
University of Michigan, 1956

The purpose of this study is to test the susceptibility to distortion of the Minnesota Teacher Attitude Inventory. Response set, knowledge acquired in professional preparation, and personality factors of rigidity, flexibility, and compliance are examined as determinants of distortion.

The sample is composed of 100 senior education students enrolled in a state teachers' college. The group contained 72 women and 28 men.

To test for distortion, the Inventory is administered under three different sets, which permits a comparison of the direction and the degree of distortion.

Assuming that the more professional knowledge one has

the more he can distort, scores on a professional knowledge test are correlated with differences between non-distorted and distorted Inventory scores.

Because it is felt that personality factors influence distortion, the factors of rigidity, flexibility, and compliance are investigated in relationship to the ability to distort.

The results of the study show that the Minnesota Teacher Attitude Inventory is susceptible to distortion. When the scores distorted in the progressive direction are compared with the non-distorted scores, a difference significant at less than the 1 per cent level is found. The difference is more significant when scores distorted in the conservative direction are compared with the non-distorted scores. In this case the null hypothesis is rejected with a high degree of confidence, the difference being significant at less than the 0.1 per cent level.

The theory that knowledge gained in professional preparation contributes to ability to distort is also supported in this study. A correlation of +.32 is found between scores on the knowledge test and differences between inventory scores. This is a significant correlation despite the fact that the coefficient of +.32 actually explains only about 10 per cent of the total variance between knowledge and ability to distort.

Personality of the subject does influence his ability to distort. The difference between non-distorted scores and scores distorted in the progressive direction is significant at less than the 1 per cent level for the compliant group. The difference between non-distorted scores and scores distorted in the conservative direction is significant at less than the 0.1 per cent level.

Subjects rated as being flexible show a difference between their non-distorted scores and scores distorted in the progressive direction which is significant at less than the 5 per cent level. The difference between non-distorted scores and scores distorted in the conservative direction for this group is significant at the 1 per cent level.

No significant differences whatever are found among the means for the rigid group.

Two conclusions can be drawn from the study. One is that since the Inventory is susceptible to distortion, there is an obvious need for scales that would make it possible to detect it and to correct for it. Another is that the Inventory should be administered under such conditions as to minimize the effect of response set, so that subjects would not be motivated to distort.

173 pages. \$2.30. Mic 57-2030

THE SOCIAL AND EMOTIONAL ADJUSTMENT OF THE GIFTED

(Publication No. 20,993)

Padmini Hannah Ramaseshan, Ed.D.
The University of Nebraska Teachers College, 1957

Adviser: Dean A. Worcester, Ph.D.

The object of this study was to test three hypotheses concerning the social and emotional adjustment of the gifted adolescents as follows:

1. The gifted and average adolescents do not differ in their social and emotional adjustment.

2. Adolescent boys and girls do not differ in social and emotional adjustment.

3. The very gifted and moderately gifted adolescents do not differ in social adjustment either with reference to sex or intelligence.

DEFINITIONS FOR THE SELECTION OF GIFTED AND AVERAGE ADOLESCENTS

The gifted in this study are those above IQ 125 in the Kuhlmann-Finch test, or the Henmon-Nelson test, or above 120 in the Otis, the Stanford-Binet or California Mental Maturity tests.

The average are those who fall between IQ's 90 and 110 in any or all of these. They were chosen as nearly as possible around IQ 100 for accuracy.

The very gifted are those with IQ's above 135 in the Henmon-Nelson or the Kuhlmann-Finch test or above 130 in the Stanford-Binet, the Otis or the California Mental Maturity test.

The moderately gifted are those individuals with IQ's between 125 and 135 in the Henmon-Nelson or the Kuhlmann-Finch or between IQ's 120 and 130 in the Stanford-Binet test, the Otis or the California Mental Maturity test.

Subjects were rated,

- a) by teachers on a five-point in social adjustment,
- b) in the Washburn Social Adjustment Inventory for traits of truthfulness, helpfulness, alienation, sympathy, purpose, impulse judgment, control, and wishes-meaning superior wishes for social adjustment.

FINDINGS

I. Analysis revealed that the following differ significantly. Results favored the gifted. (.001 level in the t-test.)

- a) The gifted and the average
- b) The gifted girls and the average girls
- c) The gifted boys and the average boys

Gifted boys and girls differ at the 5 percent level but average boys and girls differ at the 1 percent level of significance. The results favored the girls.

II. a) In total social adjustment, the very gifted and the moderately gifted do not differ in the Washburne test or in the teacher ratings either with reference to sex or intelligence.

b) The very gifted and moderately gifted differed significantly at the 5 percent level in the F-test in the Wishes score for the Washburne test with reference to sex and intelligence.

III. A comparison of mean scores revealed that the teachers' ratings in social adjustment are higher than the scores measured in the Washburne test.

The conclusions suggested in the analysis are as follows:

- 1. The gifted reveal superior social adjustment as compared to the average and that the girls in this group are better socially adjusted than the boys.
- 2. There is less disparity between the social adjustment of the gifted boy and the gifted girl than between the average girl and the average boy.
- 3. Among the very gifted and the moderately gifted, there is no difference in total social adjustment. However, the very gifted differ from the moderately gifted by having superior concepts for social adjustment.

It is possible that,

a) In a restricted environment the superior wishes are difficult to be expressed, or

b) The gifted lack motivation for the expression of these superior wishes. 165 pages. \$2.20. Mic 57-2031

AN EVALUATION OF CHANGES IN PARENTS' ATTITUDES TOWARD PARENT-CHILD RELATIONSHIPS OCCURRING DURING A TELEVISED PROGRAM OF PARENT PANEL DISCUSSIONS

(Publication No. 21,260)

Armas Wayne Tamminen, Ph.D.
University of Minnesota, 1957

An inventory of parents' attitudes toward child behavior was constructed and used for measuring changes in mothers' attitudes occurring in viewers of a series of televised parent-education programs. The programs consisted of a series of 15-minute discussions by panels of parents moderated by a child psychologist. Different parents participated in each panel. Duluth mothers were urged to view in neighborhood homes, to continue the discussions, and to submit comments. The programs were planned to modify attitudes by provoking discussion of factors underlying child behavior, by minimizing defensiveness, and by maximizing participation.

The parent attitude inventory constructed contained forty-four items based on those in the Minnesota Teacher Attitude Inventory. The score on these items was used as an item analysis criterion for the selection of additional attitude items and for determining the direction of scoring. The assumption that, at the extremes, a similarity exists in basic attitudes of parents and teachers and that attitudes thus located are related to children's adjustment was examined in light of previous research and empirically tested. The inventory was administered to 200 mothers of children selected by teachers as either unusually well or poorly adjusted. Despite many factors which diminish the relationship between such a rating of child adjustment and mothers' attitudes, the difference in mean attitude scores of the two groups of mothers was significant at the 5% level.

Because these teachers' judgments of pupil adjustment were related to economic status, samples of high and low scoring mothers were selected with proportional distribution conforming to local occupational distribution. The behavior of the children of these mothers was rated by teachers on a scale constructed for that purpose. Children of high scoring parents were rated as better adjusted, with mean difference significant beyond the .001 level. The corrected split-half reliability of the attitude inventory was .93; test-retest reliability was .91.

When the television programs started, the attitude inventory was mailed to samples of 400 viewers and 100 non-viewers from populations of Duluth mothers of grade school children who returned the forms indicating their intention to either view or not view the programs; 85.4% returned it. A second copy of the inventory was mailed after the programs, with 88.6% return. The viewers were classified into fourteen groups according to the combinations of numbers of programs viewed individually and in parties. These groups were considered samples from different strata of the viewing population.

Results

The initial mean score of the group which did not intend to view the programs was significantly lower than that of the group intending to view. Among those deciding to view, initial scores were unrelated to the number of programs actually seen, and to number viewed in groups.

No change occurred in mean attitude scores of non-viewers during the program period.

Mean scores of viewers showed an increase significant at the 5% level. The numerical increase in mean scores of those viewing all programs alone was not significant; for mothers viewing one or more in block parties the mean change was significant at the 5% level.

Analysis of variance indicated that neither the amount of total viewing or of group viewing was related to the amount of change in score; more change did not occur as more programs were viewed or more block parties attended. However, in strata viewing various numbers of programs with only 1-3 in block parties, the total number or programs viewed was associated with attitude change.

Attitude changes occurring among viewers were at best slight. However, dramatic changes in basic attitudes were not expected for such a short program series. Even such slight changes in large audiences would suggest further exploration of the value of group viewing of televised programs.

205 pages. \$2.70. Mic 57-2032

PERSONALITY OF THE DELINQUENT GIRL

(Publication No. 20,912)

Leo John Trese, Ed.D.

Wayne State University, 1957

Adviser: Edgar G. Johnson

The purpose of this study was (1) to present a statistical description of delinquent girls in the light of certain selected factors which are commonly accepted as being influential in the development of personality; and (2) to determine whether the delinquent girl exhibits a negative concept of herself in relation to her human environment, and whether the degree of negativeness varies directly with the number of unfavorable personality-influencing factors that have been present in her life. The subjects chosen for the study were the total population of a semi-private residential school for delinquent girls. The total number of subjects was 101. The principle research tools used were the interview and the questionnaire. In the interviews each girl was asked to tell her life history to the investigator. Tape recordings were made of the interviews and later transcribed to typescript. The questionnaire was administered to the entire group. Its purpose was to provide easy quantification of the data that were scattered through the unstructured interview. Interviews and questionnaires were checked against the subjects' case histories in the school files.

Items on the questionnaires were totaled to provide a statistical description of the subjects and also to provide a basis of comparison with similar statistics pertaining to delinquent boys. A distribution was then made of the 101 girls by assigning arbitrary scores to nine selected personality-influencing factors (early onset of menses,

broken home, mobility of home, frequent change of school, alcoholism in the home, constant quarreling of parents, mother employed outside of home, religious non-practice of parents, and religious non-practice of girl), and by scoring each girl according to the number of these influences to which she had been exposed. In the resultant distribution, the range of scores was from 2 to 34, with the mean at 17 and a standard deviation of 7.6. Using a table of random numbers, one interview each was selected from the mean and from one and two standard deviations from the mean in each direction. These five interviews then were submitted to content analysis under eleven categories: the girl's concept of self in relation to mother, father, male siblings, female siblings, male adults, female adults, male peers, female peers, home, society, and self. The interviews were analyzed for expressions of positive, negative or neutral feelings under each category. The number of expressed feelings was then totaled for each category and totaled also for the interview as a whole. As an index of personality health, the total positive feelings expressed in each interview were divided by the total of negative feelings expressed.

The statistical description of our subjects revealed a few notable differences between them and institutionalized delinquent boys, particularly in the higher incidence of broken homes (girls 73 per cent vs. boys 45.7 per cent), in the higher incidence of mothers working regularly outside the home (girls 66 per cent vs. boys 20.4 per cent) and in the later age of girls at first appearance of serious deviant behavior (girls 12.2 years vs. boys 8.35 years). The indices of personality health for the five girls whose interviews were subjected to content analysis, ranging from the girl most heavily loaded with delinquency inducing factors (score 34) to the girl least heavily loaded (score 2) were respectively .29, .66, .55, .61, and 1.14. The tentative conclusions were reached that girls exposed to delinquency-inducing factors do tend to exhibit a preponderance of negative feeling; that from those most heavily loaded with such factors to those least heavily loaded there is a notable decrease in the amount of negative feeling, but that among those within one standard deviation from the mean there is no notable variation.

249 pages. \$3.25. Mic 57-2033

AN EVALUATION OF DIFFERENTIAL PREDICTION FOR COUNSELING AND GUIDANCE

(Publication No. 20,991)

Dean Kay Whitla, Ph.D.

The University of Nebraska, 1957

Adviser: Dr. Charles O. Neidt

The purpose of this study was to evaluate through the methodology of multiple discriminant analysis the potential effectiveness of test scores for advising students in the selection of college or major, and to propose a statistical method for combining the test data into a predictive formula which indicates the most appropriate college or major for a student. The hypotheses to be evaluated were: (1) and (2) that it is possible statistically to differentiate successful graduates in various colleges and majors of the

University of Nebraska according to the patterns of their entrance test scores; (3) that there is a unique academic patterning for women as contrasted with that for men; and (4) that there is a sharper line of demarkation among majors than among colleges.

The sample for the study consisted of all of the "in course" graduates of the classes of 1952 and 1953 at the University who had complete test score records. This constituted 269 women and 533 men. The independent variables (Rank-in-Class, English Usage, Social Studies, ACE Linguistic Score, ACE Quantitative Score, Science, Chemistry and Mathematics I and II) are continuous and normally distributed. The dependent variable (college or major) is an unordered series, and represents a single external criterion; therefore, the multiple discriminant function is the appropriate technique for the problem. The multiple discriminant function in matrix notation was developed, and a formulation obtained which is of the general latent root or eigen-value form $(W^{-1}A - \lambda I)v = 0$ where W and A are the within and among sums of squares matrices, λ is the latent root, I is the identity matrix, and v is the latent vector.

Three significant roots were obtained for each: males-majors, males-colleges, and females-majors; and two significant roots were obtained for females-colleges. They revealed significant discrimination among both colleges and majors, and therefore hypotheses one and two were sustained. Considerable difference exists in the sizes of the latent roots which were obtained for men and women, and in the positioning of their respective sigma ellipses. Whereas the third hypothesis was sustained, further research is needed to define adequately the nature and extent of these differences. The roots for majors were significantly larger than those obtained for colleges, and therefore hypothesis four was also sustained.

By converting the elements of the latent vectors to Beta weights, the contribution of each test to the entrance test battery was evaluated. The Rank-in-Class, English and ACE-L variates proved to be the most consistent discriminants. The ACE-Q and Chemistry tests had moderate powers of separation, whereas the Social Studies and Math I and II tests were of only small value.

To facilitate determining from the discriminant solution the degree of association of a student with a group, the centour score method has been developed. A centour score for an individual gives the percentage of people deviating further from the centroid of a group than he, thus defining on the basis of test scores the most appropriate major for this student, i.e. the major where the abilities are most like his. Examination of the centour score provides available information for making such decisions and more definitive statements than can be made from the centour score are not justified from the test data. Despite the group overlap caused by limitations of the entrance battery and the similarities of the majors, it seems evident that within a total developmental guidance program, the information provided by the multiple discriminant analysis should prove to be of value.

85 pages. \$2.00. Mic 57-2034

A STUDY OF SELECTION FACTORS AND THE DEVELOPMENT OF OBJECTIVE CRITERIA FOR MEASURING SUCCESS IN A CO-OPERATIVE GENERAL MACHINE SHOP TRAINING PROGRAM

(Publication No. 21,375)

Donald Frederick Worpell, Ph.D.
University of Michigan, 1956

This study was initially undertaken to determine the relationship that existed between five paper and pencil tests, together with high school grades, and trainee success in a Co-operative General Machine Shop Training Program in a large automobile manufacturing concern. During the course of the study, however, it soon became apparent that the criteria for success, especially in the shop portion of the program, were not very discriminating; and so the project was expanded to include the development of new future criteria, in the form of progress tests.

The trainees in the above mentioned Program were high school students who, in their last two years of high school, alternated every two weeks between their high school classes and the Machine Shop training in the factory. After high school graduation they were required to train full time for an additional year in order to graduate from the Machine Shop Training Program. Four hours per week, in this program, were devoted to classroom training in mathematics and shop theory. The other thirty-six hours were for on-the-job training in the shop.

The five tests that were studied for their potential value as selection instruments were a Survey of Object Visualization, a Survey of Mechanical Insight, both by D. R. Miller, the Thurstone Temperament Schedule, a Reading Comprehension Test, and a Mathematics Test. A multiple correlation study, using the Doolittle Method to solve the normal equations, showed that these five tests and high school grades produced a multiple correlation with the criterion (shop classroom grades), of $.69 \pm .06$. A second multiple correlation study, in which the Thurstone Temperament Schedule and the Survey of Mechanical Insight tests were eliminated, produced a coefficient of $.63 \pm .06$. The writer concluded that a reasonably good selection of new trainees could be accomplished by eliminating the latter two tests from the battery and including the use of a patterned interview and a careful examination of the information obtained on the application blank.

In order to improve the grading of trainees in their shop work, four paper and pencil-type progress tests, in two forms, and four performance-type tests were developed. Learning Guides for the trainees and a Teaching Outline for the instructors were two other types of material that were prepared to better insure an awareness of learning and teaching responsibilities.

192 pages. \$2.50. Mic 57-2035

EDUCATION, TEACHER TRAINING

ANALYSIS AND CLASSIFICATION OF FOLLOW-UP PRACTICES IN SELECTED TEACHERS COLLEGES

(Publication No. 20,988)

Milton John Hassel, Ph.D.
The University of Nebraska, 1957

Adviser: J. Galen Saylor

Statement of the Problem

The purpose of the study is to analyze and classify the follow-up activities of selected teachers colleges in the United States. A secondary purpose is to obtain the opinions of educators and first-year teachers concerning the effectiveness and desirability of follow-up programs.

Procedures

A questionnaire survey of 282 colleges of education which are members of the American Association of Colleges for Teacher Education constituted the initial investigation. Six colleges having follow-up programs were visited for more intensive investigation. Reactions to their programs of follow-up service were obtained from 401 graduates of those institutions.

Findings

Of the 216 colleges responding, 28.7 per cent have organized follow-up programs, 56.9 per cent have incidental programs, and 14.4 per cent have no follow-up program.

Visitation, correspondence, on-campus conference, and area conference represent the types of follow-up activities used.

Visitation is the most frequently used type of activity with the director of placement being most often in charge of the program. All staff members are used in follow-up activities.

Eight colleges have staff members devoting full-time to follow-up. Part-time staff members in follow-up varies from one to seventy in each college.

Fifty seven colleges with organized programs give follow-up service to all first-year teachers and four colleges give the service to only teachers having difficulty.

One hour spent with each first-year teacher is the most frequent practice in the visitation activity. Twenty nine colleges observe the teaching of all its graduates while many colleges observe teaching of only those graduates having difficulty.

Thirty colleges send personal letters to each of their graduates, twenty five colleges send questionnaires, and twenty one colleges secure an evaluation from the school administrator.

Forty eight colleges using on-campus conference activity utilize workshops, laboratory school demonstrations, lectures, panel discussions, clinics, and individual conferences.

Nineteen colleges use the area conference activity which is primarily concerned with small group discussions of teachers' problems.

Staff members in the colleges visited are enthusiastic over results of follow-up and regard the activity as a part of the training of the teacher.

Of the first-year teachers surveyed, 84.3 per cent believe that graduates should be assisted by college repre-

sentatives during the first year. Of the teachers visited by college officials, 21.1 per cent indicated the visit as "very valuable", 48.7 per cent "some value", and 30.2 per cent "little or no value".

Two thirds of the first-year teachers would like the visitor to be a specialist in the field of education while a third preferred a specialist in the subject field.

On the general evaluation of the total follow-up services, 30.6 per cent of the first-year teachers rated them as "very valuable", 57.5 per cent "some value", and 11.9 per cent "little or no value".

First-year teachers ranked visitation as the most important type of follow-up activity.

Comments of first-year teachers reflect their belief in the importance of follow-up activities but they believe colleges need to evaluate their procedures to make follow-up a more helpful experience than it now is.

Educators' comments reflect that follow-up is important to improve excellence of performance of graduates and to improve pre-service preparation. They agree that lack of finances, time, and personnel are limiting factors in having a good follow-up program.

149 pages. \$2.00. Mic 57-2036

A DIFFERENTIATED LANGUAGE-ARTS CURRICULUM IN TERMS OF GROWTH LEVELS OF CHILDREN

(Publication No. 21,486)

James Curtis MacCampbell, Ph.D.
The Ohio State University, 1957

The language arts in the elementary-school curriculum form the center of the child's learning needs. The research undertaken in the study was concerned with the development of a language-arts curriculum based on the child-development approach to learning. It was organized according to the natural growth levels through which all children pass.

Results of the testing program. The data were accumulated from a testing program carried on in the public schools of Cleveland Heights, Ohio, in the years 1952 to 1956. These data, secured from tests of reading readiness, intelligence, and reading achievement, included 22,407 test scores. There were 3,094 scores included in reading readiness testing, 10,286 scores from intelligence tests, and 9,027 scores from reading achievement tests.

In reading readiness 2,773 children, or 89.6 per cent, ranked as "average and above," while only 321 children, or 10.3 per cent, were below average.

Intelligence tests revealed that 14.6 per cent of the children had intelligence quotients of 130 and above. In the range of 115 to 129 there were 37 per cent; from 100 to 114, 33.3 per cent; from 85 to 99, 11 per cent; from 70 to 84, 1 per cent; and below 70, only .2 per cent.

Median scores in reading achievement were above the accepted level for the grade. The range of scores was wide. In the first grade it extended from a low of .5 grade placement to 3.8; in third grade, from .7 to 8.7; and in sixth grade, from 2.8 to 10.7.

Nine hundred and eighty-one children took all five tests administered in first and third grades. These children were grouped according to percentile, and

the groups became the basis for proposed grouping procedures.

The data indicated the need for a curriculum designed specifically for this school situation.

Growth levels of elementary-school children. In line with the child-development approach known as organismic psychology, a curriculum in language arts based on growth levels of children instead of grade levels was developed. The emphasis was on the optimum degree of individualization of instruction in the belief that each child is different and requires a specific educational program if he is to achieve his maximum potentialities.

Conclusions are as follows:

1. The children of the school district are of higher intellectual ability than those in average public-school systems.
2. The children have a high "readiness for learning" upon entrance to school.
3. The children represent a wide range in intellectual achievement.
4. The children can be grouped for individualized instruction at various grade levels.
5. The curriculum must provide for a program of individualized instruction.
6. The program can be carried on by grouping children at each of the growth levels according to their needs, interests, and abilities.
7. Teachers require help in supervision, in-service education, and materials of instruction.
8. The lay public must be instructed concerning the proposed curriculum.

Recommendations are as follows:

1. That growth levels be inaugurated in place of grade levels
2. That growth levels consist of three groups of children each
3. That children be given highly individualized instruction in language arts in keeping with organismic psychology
4. That enrollment per teacher be kept at a maximum of twenty-five children
5. That subject matter be based on experiences, needs, and abilities of children at each growth level

The curriculum presented is not intended as a final piece of work. Constant revision based upon experience and the ever-growing knowledge in the science of child growth and learning is necessary. The curriculum is submitted as a beginning in the revision of a program of education for young children.

288 pages. \$3.70. Mic 57-2037

CURRENT PRACTICES IN THE PSYCHOLOGICAL TRAINING OF ELEMENTARY TEACHERS

(Publication No. 20,883)

Owen Ernest Pittenger, Ed.D.
University of Illinois, 1957

The purpose of this study was to determine the amount and type of psychological training currently required of elementary teachers in four year degree granting teacher training institutions.

Two levels of description were employed. The first was in terms of the general patterns of psychological training for elementary teachers. Included in this phase was the determination of the number of hours required in psychology, the number of courses required in psychology, and the patterns of required courses. This part of the survey was based on an analysis of the current catalogs of 427 institutions of higher learning which responded to a personal request for curriculum descriptions.

The second level of description was based on a detailed analysis of the content and methods of the required psychology courses as described by the instructors who taught the courses. After the catalog study had been completed a questionnaire was developed which covered the following areas: The basic textbooks used, the basic outline of the content of the course, primary and supplementary instructional methods used, and the instructor's evaluation of the most significant topics covered in the course.

A separate questionnaire was submitted to each instructor of the 1,226 psychology courses required in the 427 institutions comprising the catalog sample. Completed questionnaires on each required course were returned by 232 institutions. An additional 51 institutions returned complete information on one or more required psychology courses.

For purposes of comparison the psychology courses were classified in the following categories: General Psychology, Educational Psychology, Child Development, Child Psychology, Human Development, and Tests and Measurements.

Each group of courses was then investigated to determine the degree of internal consistency in content and methodology. The categories were also examined for the degree of mutual exclusiveness in content.

The most typical pattern of psychological training for elementary teachers was one in which approximately seven percent or nine semester hours of the curriculum were devoted to three courses in psychology. These three courses were usually either a combination of general psychology and educational psychology or a combination of general psychology, educational psychology, and child psychology.

The content of these courses was found to overlap when considered as categories. However, when the total programs of the institutions were compared a typical pattern of topics was apparent. Regardless of the course titles, course organization, or patterns of courses, the typical program included: History, Scope and Methods of Psychology, The Adjustment Process, Principles of Mental Health, Principles of Growth and Development from Birth Through Adolescence, Principles of Learning, and Principles of Measurement and Evaluation.

The primary instructional method was a combination of lecture and discussion periods with lecture series being

used infrequently except in General Psychology. Supplementary instructional techniques except for the use of audio-visual materials were as yet relatively undeveloped in those psychology courses included in this study.

106 pages. \$2.00. Mic 57-2038

**STUDENT TEACHING IN OFF-CAMPUS PROGRAMS
IN INDUSTRIAL ARTS: A SURVEY DIRECTED
TOWARD IDENTIFYING QUALIFICATIONS AND
RESPONSIBILITIES OF INDUSTRIAL ARTS
SUPERVISORS AND COOPERATING TEACHERS
AND TOWARD EVALUATING INDUSTRIAL ARTS
OFF-CAMPUS STUDENT TEACHING ACTIVITIES**

(Publication No. 20,909)

William T. Sargent, Ed.D.
Wayne State University, 1957

Adviser: G. Harold Silvius

The purposes of this descriptive-survey of off-campus programs in industrial arts student teaching were to identify commendable aspects of current programs and to apply the findings toward developing (1) an off-campus program for the Department of Industrial Arts, Northern Michigan College, Marquette, where augmented enrollments required expansion of student teaching facilities, (2) a handbook for student teachers in off-campus programs, and (3) a brochure for off-campus personnel with supervisory responsibilities.

By off-campus student teaching was meant directed teaching in a non-campus school located either in the same community or any distance from the supervising teacher-education institution.

The research was designed to determine:

1. Qualifications and responsibilities of industrial arts supervisors.
2. Qualifications and functions of industrial arts cooperating teachers.
3. Activities which (according to cooperating teachers) promoted professional growth of prospective teachers.

Respondents were 67 supervisors and 125 cooperating teachers in industrial arts off-campus programs in the United States.

Literature and research supported the basic assumption that experiences in public schools gave the student teacher opportunities to identify personal demands, qualifications, and skills inherent in industrial arts teaching.

Several conclusions were drawn on the basis of this study. The industrial arts supervisor was:

1. A specialist in industrial arts.
2. A teacher-educator on both graduate and undergraduate levels.
3. An administrator in structuring and coordinating the program.

Responsibilities of the supervisor called for:

1. Developing the professional curriculum in industrial arts.

2. Scheduling methods courses prior to or concurrently with the student teaching assignment.
3. Selecting off-campus schools on bases of industrial arts curriculum, grade level, and distance from campus.
4. Selecting cooperating teachers with minimum teaching experience of 3.5 years, Master's degree, and attributes of a master teacher.
5. Screening and assigning student teacher candidates with a maximum of two student teachers to each cooperating teacher.

In actual practice, qualifications of cooperating teachers exceeded those recommended by supervisors. A mean of 9.3 years of teaching experience was reported. Moreover, 62.4 per cent of the respondents had the Master's degree.

In his capacity of guiding the student teacher toward maximum professional growth, the industrial arts cooperating teacher:

1. Advocated inducting the student into actual teaching gradually and on individual merits of readiness.
2. Planned conferences with definite purposes as planning work or evaluating the progress of the student teacher. (Time allotted to student teaching limited the number and length of scheduled conferences).
3. Encouraged a variety of off-campus teaching experiences.

When the evaluation of 92 student teaching activities was compiled, classifications ranked in the following order:

TABLE I. RANK ORDER FOR EACH GROUP OF INDUSTRIAL ARTS STUDENT TEACHING ACTIVITIES EVALUATED BY COOPERATING TEACHERS

Classification of Activities	Total Number	Mean of Activity Index Numbers*	Rank of Importance
Actual teaching	24	123.63	1
Evaluation and guidance	14	111.48	2
Class organization	28	102.04	3
Orientation of student teacher	18	99.60	4
Community and home relationship	8	77.32	5

*Mean of index numbers for all industrial arts student teaching activities was 106.33.

Recommendations for improving industrial arts off-campus programs were:

1. Providing in-service training in directed teaching.
2. Providing more adequate orientation of cooperating teachers through conferences, work shops, and written manuals.
3. Consulting cooperating teachers before assigning student teacher to him.
4. Establishing a longer daily and weekly contact to permit more teaching experiences.
5. Providing information about the student teacher's background, interests, needs.
6. Scheduling regular conferences with the student teacher for specific functions.

The conclusions and recommendations of this study were ultimately incorporated into (1) a proposed off-campus program in industrial arts for Northern Michigan College, Marquette, (2) a handbook for student teachers, and (3) a supervisory brochure.

391 pages. \$5.00. Mic 57-2039

AN EVALUATION OF THE STUDENT TEACHING PROGRAM FOR SECONDARY SCHOOL TEACHERS AT THE UNIVERSITY OF NEBRASKA

(Publication No. 20,994)

Lauren L. Schwisow, Ed.D.

The University of Nebraska Teachers College, 1957

Adviser: Frank E. Henzlik, Ph.D.

The purpose of this study was to evaluate the student teaching program for secondary school teachers at the University of Nebraska and from implications in the findings make recommendations for its improvement.

The procedure followed in the study involved:

1. Identifying the objectives of the program.
2. Ascertaining attainment of the objectives through evaluation of selected experiences judged to contribute to their attainment.
3. Analyzing data concerning strengths and limitations of the program.
4. Analyzing suggestions submitted for improving the program.
5. Reporting findings, drawing conclusions, and making recommendations.

Data were obtained by means of questionnaires sent to supervisors of student teaching and to former student teachers.

Findings

1. The supervisors were in general agreement on the objectives.
2. The most valuable experiences in which student teachers engaged were ones dealing with responsibility in an actual teaching situation, with the evaluation of pupil growth, with the organization of subject matter for instructional purposes and with the selection and use of teaching materials.
3. Experiences of least value were those concerned with routine procedures, those in which the student teacher's role was more passive, and those about which he had sufficient knowledge or training prior to student teaching.
4. Student teachers indicated the need for including more of the following types of experiences: extra-class activities, guidance, and the ascertaining and meeting of individual pupils' needs. The desire for more knowledge of instructional resources and their uses was also indicated.
5. The plan of giving student teachers major responsibility for performing the duties of a teacher in the classroom was an outstanding strength of the program.
6. Other strengths were the supervisory and administrative staffs, the quantity and quality of materials available, the student teaching seminars, and the methods courses.
7. Factors limiting success were insufficient length of time in student teaching, lack of opportunity for observation of experienced teachers, some impractical professional education courses, and insufficient opportunity to participate in extra-class activities.

Conclusions

1. That the program adequately met most needs of the majority of the student teachers.
2. That student teachers approved the plan whereby they were given major responsibility in the classroom from the first day and throughout the entire student teaching experience.
3. Although the majority of the objectives of the program were attained, certain deficiencies were revealed. It was with the intent of inspiring action for their correction that recommendations were made for improving the program.

Recommendations

1. That evaluation of the student teaching program be a continuous and cooperative process with representatives of the following groups participating: student teachers, supervisors, administrative personnel of the campus laboratory school, and the faculty of Teachers College.
2. That the program be expanded to include the opportunity for students to teach in both their major and minor fields.
3. That the program of observation be modified to make possible the inclusion of more directed observation of experienced teachers at both the campus laboratory school and at off-campus schools prior to and during student teaching.
4. That a plan be developed in which student teachers have opportunity to function as full-time teachers to provide experiences with high school students outside the classroom, to permit more active participation in the guidance program, and to develop a better understanding of the total school and of school-community relationships.
5. That student teachers be given more guidance in identifying individual differences among their pupils and in meeting the peculiar needs of each.
6. That minimum standards of supervision be established that are consistent and objective, yet flexible enough to allow for variations within instructional areas and for differences in student teachers' needs.
7. That students preparing for student teaching be given opportunity to become familiar with a wide variety of materials and resources available for use in their respective instructional areas.

226 pages. \$2.95. Mic 57-2040

TECHNICAL OFFERINGS FOR INDUSTRIAL ARTS TEACHERS AT THE GRADUATE LEVEL

(Publication No. 21,262)

Ray Arthur Wigen, Ph.D.

University of Minnesota, 1957

The purpose of this study was to determine the nature of technical offerings, to determine a legitimate and essential basis for the inclusion of technical offerings in the preparation of industrial arts teachers, and to prepare a guide for administrators and others interested in technical offerings for industrial arts teacher education at the master's degree level.

To attain the three purposes of this study, a careful survey of literature was undertaken, necessary survey instruments were prepared, and a method was devised for validating the guide for technical offerings at the master's degree level.

First, the literature was surveyed to obtain the data to characterize the specific nature of technical work at the graduate level.

Second, the survey of literature in the general field of graduate work resulted in the identification of thirty-four general theories. These theories were redefined by the writer, prepared in a form suitable for survey purposes and sent to twenty deans of graduate schools for evaluative purposes. As a result of this procedure, the thirty-four theories were reformulated as nine comprehensive general theories.

Third, the nine general theories were redefined in terms of specific theories related to technical offerings. These in turn were further characterized in terms of seventy-seven statements of expected behavior patterns and learning experiences and prepared in the form of a survey instrument for evaluative purposes. The questionnaire was sent to sixty directors of industrial arts graduate work to secure their reactions. Eighty-three per cent of the directors completed the instrument. The range of responses of agreement with the items that characterized the nature of technical work was from 72 to 100 per cent.

Fourth, the guide for technical offerings was developed on the basis of the constructive criticisms of the fifty directors of industrial arts graduate programs. The eight theories and detailed statements of theories pertaining to technical knowledge, technical performance, creativeness, research, cognate areas, differentiated curriculum, student standards, and curriculum procedures were prepared in a form that permitted an administrator or teacher of technical work to develop or evaluate a technical course.

Fifth, the effectiveness of the guide was tested by twelve experienced administrators and teachers who used the instrument to evaluate their technical courses at the graduate level. The reactions of the respondents to selected criteria for evaluating the general worth of the guide indicated that the guide was usable and could serve as an effective aid in the development or evaluation of technical courses.

The conclusions that appear to be justified in this investigation are as follows:

1. There was sufficient agreement by experienced personnel concerning the general nature of graduate work to permit the formulation of general theories of graduate work.
2. The general theories of graduate work pertained to and were applicable to the specific field of technical offerings.
3. Sufficiently high agreement among fifty directors of industrial arts graduate work was secured for the nine specific theories of technical offerings and seventy-seven detailed statements of evidences of expected student abilities, and samples of instructional activities to justify their use in a guide for administrators interested in the problem.
4. Administrative guides for curriculum development should be prepared in a form that permits the administrator to select theories and details of the theories that are consistent with his institutional purposes.
5. Comments by the respondents who used the guide for evaluating their technical courses indicated that they were cognizant of the strengths and weaknesses of their technical offerings.

6. The reactions of the respondents to the check list concerning the general worth of the guide indicated that the guide was usable for developing or evaluating technical offerings.

195 pages. \$2.55. Mic 57-2041

EDUCATION, THEORY AND PRACTICE

OUTLINE OF A PHILOSOPHIC POSITION AND ITS APPLICATION TO AN INTRODUCTORY MUSIC PROGRAM IN GENERAL EDUCATION

(Publication No. 21,061)

Laszlo Joseph Hetenyi, Ed.D.
Michigan State University, 1956

This study presents a philosophic position which regards the sentient individual as the creator of both knowledge and reality. The pragmatic criterion, operating in relation to the individual's experience, determines what is real no less than what is true. Objective existence is employed only as an operational concept, devoid of special ontological position, meaningful only as it operates to promote the purposes of the sentient being.

In consequence, a value system is evolved which maintains that conduct promoting an individual's capacity to deal with his experience (notably through a growth in his capacity to anticipate consequences) is ethically positive, while the converse is ethically negative. At present, maximum growth is seen as occurring in a social context, hence social value is regarded as the most acceptable criterion for evaluating human conduct.

The aesthetic experience is analyzed as a need-satisfaction occurring in the appreciator--the need arising from repeated frustration in daily life of man's tendency toward organized (formally complete) perception. In this process the aesthetic object is granted existential status only as it participates in the experience of the beholder.

In relation to education, this position implies a concentration on the experience of the individual learner, while demanding adequate allowance for the apparent reality of his surroundings in both the cognitive and the evaluative areas. As a part of the latter, preoccupation with the aesthetic emphasizes the promotion of skills and attitudes leading to increased development of formal completeness in the student's personal experience.

An introductory music course in general education based on this position must contain a minimum of seven basic objectives. The program must (1) address itself to the development of the individual. It must (2) produce certain social attitudes to (3) extend and (4) intensify the musical experience. It must (5) restructure this experience in terms of musical form and (6) bring about the requisite dynamic conditions through a modification of existing attitudes. Finally, it must (7) provide a foundation for integrating musical growth with the totality of the experiential field.

In realizing these objectives it is necessary to determine the developmental status of students at the outset and to organize the program with sufficient flexibility to allow for individual differences. Content and methodology are

selected with due regard for the environment of the clientele, but provisions must be made to permit subsequent expansion of experience beyond this setting. Perception of stimuli presented through the four musical elements (rhythm, melody, harmony, tone color), also retention in memory of such stimulation, must be fostered. Presentation of these elements must occur in a structurally organized setting (i.e. through examples having formal integrity) and provision must be made to advance from this level to a perception of musical design. Some procedure must be devised to coordinate the resultant musical growth with development in other areas of experience.

An extensive sample program illustrating concrete application of this approach completes the study.

271 pages. \$3.50. Mic 57-2042

THE NEED FOR AND NATURE OF ONE TYPE OF COURSE IN MATHEMATICS FOR GENERAL EDUCATION AT THE COLLEGE LEVEL

(Publication No. 19,497)

Kathrine Carrie Mires, Ed.D.
The University of Oklahoma, 1956

Major Professor: Glenn R. Snider

The purpose of the study was to determine the extent to which there is need for a college-level course in mathematics for general education which has as one of its chief objectives the improvement of functional competence in mathematics and to investigate the nature of the content related to functional competence which should be included in such a course. It was assumed that the mathematical concepts and abilities necessary for functional competence were those which were recommended as a part of the general education of all citizens by the Commission on Post-War Plans of the National Council of Teachers of Mathematics.

The Davis Test of Functional Competence in Mathematics was administered to 1811 entering college freshmen at the six state colleges in Oklahoma in the fall of 1955, and the results were studied by means of a statistical treatment of scores and an item analysis. An additional means of interpreting the test results was obtained by considering the opinions of a group of twenty-six selected mathematics teachers and administrators as to which items on the Davis Test deal with knowledge which is essential for the college student whose major field does not require specialized training in mathematics. The mean number of items considered essential by the judges was then used as a minimum satisfactory score with which to compare the performance of the subjects.

The following conclusions were drawn from the study:

1. Only a very few of the entering college freshmen tested had a satisfactory understanding of and an ability to use the essentials for functional competence in mathematics.
2. There was a definite need in the six state colleges in Oklahoma in the fall of 1955 for a general mathematics course which included work designed to improve functional competence.
3. The group of entering freshmen tested lacked func-

tional competence in all areas covered by the test, but they showed greatest deficiency on the following topics: (1) drawing conclusions, (2) estimating answers, (3) measurement, (4) use of approximate numbers, (5) basic geometric concepts, (6) reading and interpreting tables, (7) use of formulas, (8) consumer problems involving per cents but also requiring some other knowledge, (9) basic algebraic simplification, and (10) ratio and proportion.

4. A course in mathematics for general education which has as one of its chief purposes the improvement of functional competence might well include work on any of the mathematical concepts covered by the Davis Test, but emphasis should be placed upon the ten topics on which greatest lack of competence was shown.

In a final section suggestions as to content and organization of a college-level general mathematics course of the type considered here were discussed and some implications of the study in regard to high school mathematics programs were presented.

107 pages. \$2.00. Mic 57-2043

ORGANIZATIONAL RELATIONSHIPS OF THE OFFICE MANAGER

(Publication No. 21,455)

Louis Howard Schuster, Ph.D.
The Ohio State University, 1956

The basic aims of the study were to determine the organizational relationships of office managers — their position, authority, and scope of responsibility; to delineate the specific functions and activities of office management executives; to discover the extent of centralization and decentralization in the office area; and to secure data and make significant recommendations to business education in the performance of its function of preparing prospective clerical and office management personnel.

Some collateral purposes of the over-all investigation were to determine the extent to which the position of office manager is used in business firms; to collect certain pertinent data regarding training, salaries, and titles of office management executives; to investigate direct and indirect spans of control; and to determine the extensiveness of the use of organization charts and job descriptions.

The data were collected by means of a normative survey. The sample comprised business firms located in Virginia, Columbus, Ohio, and other sections of the United States. In answer to 319 questionnaires sent, 135 replies (42.3 per cent) were received. The data used for the study were 96 responses, comprising 30 per cent of the total sample. The 96 office management executives represented responses from 49 firms in Virginia, 26 in Columbus, Ohio, and 21 elsewhere in the United States.

Participants in the study submitted data from firms representing the several industrial classifications listed in the Statistical Abstract of the United States. The data included large, medium-sized, and small firms.

The data revealed that organization charts of the entire firm were prevalent among 55.3 per cent of the enterprises surveyed, although they were used to a lesser

extent among the smaller Virginia and Columbus, Ohio, firms than among the larger firms of the national group.

Although 36.4 per cent of the office management executives participating in the study used the title "office manager," various other titles were used to designate the position. Most of the office management executives (67.7 per cent) were college trained.

The data showed that offices ranging in size from fewer than six employees to more than five hundred were supervised by office management executives. Variations were evident in the three geographical areas, the medians of office sizes being 19, 24, and 113 among firms in the Virginia, Columbus, Ohio, and national groups respectively. Analysis of the spans of control by office executives revealed that 60.9 per cent supervised more than a total of 25 employees. The most frequent span in the case of direct supervision was from three to eight persons, although no set pattern appeared for all office management executives.

It appeared from the study that the size of the office is only one factor determining the use of an office manager.

Other factors are the complexity of office management functions and activities and the necessity of coordinating office services for department heads.

A set pattern of office functions performed by office management executives tended to cluster around conducting tests and preparing work forecasts, office manuals, and so on. On the other hand, office management executives among the firms studied tended to supervise a wide range of office activities, without a prevailing pattern.

Those activities that involve the mailing service, the telephone and telegraph service, the handling of office supplies, duplicating, and so on, were centralized. The degree of centralization of office activities varied, but there was a greater degree of centralization among the larger national firms than among the smaller local firms. In like manner, job descriptions of the office management position were not as widely used by the smaller firms participating in the study as by the larger firms.

364 pages. \$4.65. Mic 57-2044

ENGINEERING

ENGINEERING, GENERAL

SOME PRODUCTION PLANNING PROBLEMS

(Publication No. 21,120)

Morton Klein, Eng.Sc. D.
Columbia University, 1957

Two classes of production planning problems involving costs which are all either concave or convex functions are studied.

The first class, usually labeled "allocation" problems, contains problems of which the "basic scheduling problem" described below is typical.

The basic scheduling problem: Given a fixed quantity of material to produce on or before a specified delivery date, production is to be scheduled among the number of periods available in such a way as to minimize total costs. It is assumed that the capacity of the plant or machine being utilized is known for each period within the interval of interest. Capacity here is defined to be the maximum output attainable within the structure of applicable restrictions imposed on the plant. It is assumed that the costs of production during each period is a concave (convex) function of output.

The second class consists of scheduling problems in which, in addition to meeting a terminal demand, a schedule in terms of meeting a series of intermediary requirements must also be fulfilled.

Section II contains a summary of the considerations which lead to an interest in concave and convex cost functions for production planning problems.

It is well known that set-up costs and other kinds of fixed charges have been difficult to handle computationally in linear programming problems. It has been shown for linear programming problems involving fixed charges, under the assumption that they are the same for all activities, and also under conditions of non-degeneracy, that these costs can be ignored in the attainment of optimal solutions. In Section III, it is shown that set-up charges can be included in the scheduling cost model involving concave functions without any additional inconvenience.

The main portion of Section III is concerned with the basic scheduling problem. For cases involving concave cost functions, a theorem specifying the form of the optimal solution is utilized to develop a production plan for a special case. This case occurs when the production cost function is assumed to be invariant in time and inventory charges are assumed to be linear. The interest in this and other special cases is motivated by the combinatorial aspects of the solution to the general problem. These special cases are also used to develop approximate solutions for less restrictive conditions. For allocation problems involving convex functions, a computational procedure which allows for the repeated application of a very simple graphical technique is developed.

In Section IV, the problem of scheduling to meet a series of requirements is studied. The well-known results

of Modigliani and Hohn are extended to cases in which the convex cost functions may be arbitrarily different for each period and in which the variables are bounded. It is shown that the "planning horizon" decomposes at certain critical points for these more general conditions. For the problem involving concave functions, a computational procedure is given for the special case considered in the section on the basic scheduling problem. It is shown that an established industrial practice of setting back production by an amount just sufficient to meet the schedule, leads to minimal cost production schedules for this case.

93 pages. \$2.00. Mic 57-2045

ENGINEERING, AGRICULTURAL

AN ANALYSIS OF THE WOOD-CUTTING PROCESS

(Publication No. 21,178)

Norman Charles Franz, Ph.D.
University of Michigan, 1956

The purpose of this research is to determine key phenomena associated with the wood-cutting process, and to investigate the controlling factors and relationships. Because the scope of a comprehensive investigation was deemed far too broad for consideration, the study is limited to selected conditions of cutting offering the greatest promise of contribution to knowledge which may be expanded in future research.

Orthogonal cutting parallel to the grain is selected as the method of machining which yields the most useful information. An analysis of the wood-cutting process is accomplished by observational studies of the chip during formation, and by simultaneous determination of attending forces on the cutting tool, together with a determination of the mechanical properties of the material being machined. Principal variables include species, moisture content, cutting angle, and chip thickness. In more limited phases of the research, cutting velocity, friction at the interface of the chip and the tool, and grain deviation are taken into consideration.

Observational studies of the cutting process identify three basic types of chip formation, each attended by characteristic failures in the wood ahead of the cutting tool. The Type I chip is formed when the wood fails intermittently in cleavage. Type II develops by essentially continuous failure in a plane extending from the tool edge to the work surface. In the Type III chip, wood failure appears to be in compression and shear, which in some instances causes development of a built-up edge on the cutting tool.

Each of the types of chip formation generates a characteristic surface which reflects the nature of associated wood failures. Further, the instantaneous tool forces

attending each chip type display specific patterns of development which correlate with failures in the wood.

Chip formation proves to be dependent on interactions of wood properties and cutting geometry, but independent of cutting velocity. Wood mechanical properties exert control of the cutting process by defining the type of wood failure resulting from a given force system applied by the cutting tool. Both wood species and moisture content are observed to influence the cutting process through according differences in the relationships of mechanical properties.

Cutting geometry exhibits control of chip formation through the forces exerted on a given work piece. Cutting angle of the tool and undeformed chip thickness are found to have marked effects on tool force values which, with attending wood properties, determine the nature of failures in advance of the tool.

The coefficient of friction between the chip and the face of the tool is indicated to be an important machining factor, the value of which proves to be a function of wood species and moisture content. Roughness of the tool face appears to have an inconsequential effect on friction when grinding marks parallel the motion of the chip.

Analysis of the mechanics of chip formation by methods established for metals appears to be limited. However, a suitable analysis for wood is derived which appears to be consistent with the results of cutting experiments. An equation is suggested which determines chip formation, hence surface quality and machining efficiency, as a function of friction, cutting geometry, and wood mechanical properties. 187 pages. \$2.45. Mic 57-2046

DESORPTION ISOTHERMS AND DRYING RATES OF SHELLLED CORN IN THE TEMPERATURE RANGE OF 40° TO 140°F.

(Publication No. 20,216)

Jorge H. Rodriguez-Arias, Ph.D.
Michigan State University, 1956

The investigation is primarily concerned with an experimental inquiry into the theoretical aspects of grain drying with the broad objective of gaining fundamental information pertaining both to the equilibrium and to the rate relationships of the drying process, with particular reference to shelled corn.

The experimental phase was directed toward obtaining hygroscopic equilibrium data over a wide enough range of constant drying conditions to permit the accurate construction of desorption isotherms for temperatures of 40°, 60°, 86°, 100°, 122°, and 140°F. A static method was used whereby thin layer samples of grain were equilibrated above saturated aqueous solutions of chemically pure salts maintained in thermostatically controlled constant-temperature cabinets. Data obtained throughout the equilibration period allowed accurate construction of drying curves corresponding to the testing conditions.

When examined with the B.E.T. two-constant equation the isotherms were found to yield very satisfactory linear plots in the prescribed region of validity as well as reasonable values for the equation constants. Further treatment with the B.E.T. three-constant equation and the

Harkins-Jura equation led to the conclusion that multimolecular adsorption is the predominant water-binding mechanism in shelled corn. The analysis strongly suggests that in the region of relative pressures from zero to 0.75 the adsorbed water consists of a first unimolecular layer of firmly bound molecules plus four to five additional layers of decreasingly bound molecules; that beyond a relative pressure between 0.30 and 0.45 enough lateral interaction between adsorbed molecules develops to cause the formation of a condensed film, with condensation in increasingly larger capillaries occurring beyond a relative pressure of about 0.75. The isotherms were found to obey Smith's equation in the range of relative pressures from 0.45 to 0.90. The average isosteric heats of desorption at various moisture levels from 8 to 22 percent, dry basis, over the temperature range from 60° to 122°F were calculated by three different methods, all based on the Clausius-Clapeyron equation.

Henderson's equation successfully describes the isotherms in the relative pressure range between 0.10 and 0.60, but it tends to considerably understate the sorption beyond that range and to slightly overstate it at the lower pressures. Furthermore, with single-valued constants the equation fails to account correctly for the temperature dependence of the isotherm.

The thin layer behavior of shelled corn was found to obey closely an exponential drying law analogous to Newton's law of cooling. However, the rate constant was found to decrease according to stepwise discrete changes in value at various intervals throughout the drying process, which seriously hinders the usefulness of the simple equation. The instantaneous vapor pressure potential appears not to be the most important single factor governing the instantaneous drying rate; widely divergent drying rates occurred under identical vapor pressure potentials. Over restricted ranges of moisture content the drying rate could be characterized by an equation analogous to Ohm's law with the vapor pressure potential as the driving force and the reciprocal of a mass transfer coefficient as the resistance. Electromagnetic irradiation of shelled corn at a moisture level of 15 percent, dry basis, with doses of 10^6 and 10^7 reps applied on both sides of the corn kernels had no noticeable effect on the drying rate.

205 pages. \$2.70. Mic 57-2047

ENGINEERING, AERONAUTICAL

AN IMPROVED METHOD OF ANALOGUE MULTIPLICATION

(Publication No. 21,182)

Vincent Siering Haneman, Jr., Ph.D.
University of Michigan, 1956

The problem investigated in this work is the improvement in analogue multiplication obtained by a new method of programming existing multipliers. The importance of analogue multipliers which provide both high static accuracy and good dynamic performance is discussed briefly.

The basic concept of the new multiplier method is the

use of the error signal of a multiplier to correct the output product. This method requires a second multiplier to perform the correction multiplication, which is then summed with the original output product.

The improvement in multiplier performance is analyzed for idealized multiplier elements by considering the multiplier output for sinusoidal inputs. The measure of improvement is determined by considering the error ratio, which is defined as the peak value of the sinusoidal error divided by the peak value of the sinusoidal input. This ratio takes into account the phase shift and amplitude distortion of the various units.

After discussion of the improved performance using the idealized units, the error ratio of actual units is presented to show the increased accuracy possible with proper programming.

When the second multiplier has low frequency drift in its output, it is desirable to eliminate this from the correction product that is summed with the original product. This is accomplished by the use of a high pass filter on the output of the correction multiplier. Situations under which the high pass filter is desirable and the benefits that can be gained are discussed with reference first to the idealized units and then to the actual analogue multipliers.

The integration of the product of the error ratio times the Fourier amplitude of the input to the multiplier with respect to frequency will give a measure of the errors introduced into the solution by the multiplier. This can then be used to evaluate the various methods and combinations of multipliers that can be used.

Two linear and two nonlinear equations were solved of the electronic differential analyzer type of analogue computer to demonstrate the improvement in the problem solution by use of this method of programming. Each equation was solved with and without the new method of programming the multipliers. In each case the computer solution was run at a slow rate and at a fast rate so that the problem spectrum presented to the multiplier covered a different portion of the error spectrum of the multipliers and demonstrated the improved accuracy of the multipliers. Further demonstration of the total accuracy of the solution was made by comparison of the solutions obtained above with the theoretical or numerical solution of the equation.

A section of the work covered the construction, operation and error analysis of a crossed-fields multiplier, similar to the one designed by A. B. Macnee. This unit was used with the electronic differential analyzer type of analogue computer.

One of the equations used for the demonstration of the quality of the multiplication and its effects on the solution was Van der Pol's Equation. A table of values of the function and its first derivative are presented. These values were obtained from a digital solution of the equation and an error analysis of the digital solution, while not complete, is presented. An important observation is that the maximum value of the function is not 2.00 as previously assumed but is a function of the coefficient of the first derivative term.

The results obtained from this work show that it is possible to combine two analogue multipliers of fair accuracy and obtain a composite unit that has superior performance to either unit separately.

215 pages. \$2.80. Mic 57-2048

THE MECHANISM OF COMBUSTION OF AN AMMONIUM PERCHLORATE-POLYESTER RESIN COMPOSITE SOLID PROPELLANT

(Publication No. 20,161)

George Sharp Sutherland, Ph.D.
Princeton University, 1956

Supervisor: Martin Summerfield

Solid propellants composed of finely-divided crystalline oxidizers uniformly dispersed in asphaltic, rubbery, or plastic binders are known as composite solid propellants. Composite propellants are utilized in applications such as JATO rockets, missile boosters, and gas generators. Improvements in the ballistic characteristics of these propellants have generally resulted from experimental tests. A clear picture of the detailed mechanism by which the solid is transformed to hot gases has been lacking.

Accordingly, an experimental investigation was made of the combustion mechanism of a composite solid propellant. The propellant selected for study was composed of ammonium perchlorate (oxidizer) and a polyester resin (fuel). A practical result of such an investigation would be, for example, a model predicting the effect of the oxidizer particle size distribution on the burning rate that would reduce the length and expense of tests designed to provide this information. A clearer understanding of the combustion mechanism may also help solve such problems as unstable and erosive burning.

A more fundamental problem met in the study of this propellant is concerned with describing the flame itself, which is an intermediate type between a premixed and a pure diffusion flame. Such intermediate flames have received scant attention in the literature and have great practical importance.

The experiments were chosen to yield information about the structure, dimensions, and location of the gaseous reaction zone. In particular, evidence was sought concerning the hypothesis that the feedback of thermal energy from the flame to the surface controls the burning rate.

Consequently, gas phase temperatures were measured by an instantaneous, optical brightness-emissivity technique using Na D line emission. Due to the small dimensions of the reaction zone, the method was refined for use in regions smaller than 100 microns in length. Temperature profiles in the solid and gaseous phases were also obtained with Wollaston wire thermocouples embedded in the propellant. These studies indicate that maximum flame temperatures are reached within 50 microns of the surface.

Spectrographic studies showed that CN, NH, C₂, and CH are transient radicals present in the reaction zone. The dimensions of the reaction zone as defined by these radicals appears to be less than 500 microns. C₂ and CH are formed before CN and NH, indicating that the fuel is decomposed before the oxidizer.

Strand burning rate tests provided data concerning the effect on the burning rate of such variables as mixture ratio, oxidizer particle size, and pressure. The propellant burning rate r exhibits a stronger pressure dependence at low pressures ($r \sim P^{0.7}$) than at high pressures ($r \sim P^{0.4}$). Coarse oxidizer particles reduce the pressure dependence at low pressures.

Ordinary and schlieren photography and high-speed

cinematography were used to explore the burning surface of the propellant and the flame structure. These pictures showed that each oxidizer crystal protrudes into the gas zone as the fuel vaporized from around it. During decomposition, the oxidizer crystal is surrounded by its own decomposition flame, the products from which then undergo further reaction with the fuel vapor.

Application of the intermediate flame concept to composite solid propellant combustion has yielded a model where the flame is considered as a heterogeneous mixture of pockets and streamers of fuel-rich and oxygen-rich gases whose rate of transformation to products is controlled by the competing mechanisms of molecular diffusion and chemical reaction rates. This model successfully predicts the observed behavior of the propellant under the influence of pressure, mixture ratio, and oxidizer particle size.

Investigations that could provide additional information concerning the burning mechanism of composite propellants include a study of the decomposition of single oxidizer crystals in inert and reducing atmospheres. Experiments with different oxidizer-fuel combinations should be undertaken to test the range of applicability of the intermediate flame model. 252 pages. \$3.25. Mic 57-1979

ENGINEERING, CHEMICAL

FREE SETTLING OF FIBERS IN FLUIDS

(Publication No. 20,812)

Ardeshir Rashid Aidun, Ph.D.
Syracuse University, 1957

Supervisors: C. S. Grove, Jr., and H. P. Munger

The purpose of this investigation was to study the rate of fall of fibrous materials in several liquids and to develop an equation so that the rate of fall of fibers could be predicted from known physical constants.

The fibers considered were nylon, viscose rayon, "Orlon," "Dacron" and cotton. The fluids used were distilled water, acetone, methyl alcohol, and benzyl alcohol. The temperature of the fluid was controlled and maintained equal to that of the room.

Before measuring the rate of fall, the fibers were cleaned of any external coating and also were soaked in the fluid in which their rate of fall was to be determined. The fibers were dropped at the top of the fluid column and the time of fall through a known height of fluid column was recorded.

The usual convention in fluid and particle dynamics is to find the frictional force or the drag coefficient from a dimensionless group which contains as few physical quantities as possible, which quantities require an experimental set up for their determination.

The following conclusions were formed as a result of this investigation.

A fiber while falling through a fluid medium assumes the shape of a catenary depending on its diameter and length. The larger diameter fibers fall horizontally with their axis normal to the direction of motion.

The rate of fall is dependent on the length of the fiber up to one-half a centimeter. The rate increases with length and reaches a maximum at one-half a centimeter and then becomes independent of the length.

Lamb's Equation, when modified as follows, was found to describe the rate of fall as a function of Reynolds number, Re :

$$K' = 1.9 - 1.29 \ln Re$$

Equations of practical value have been determined by correlating drag coefficient and Reynolds number. These equations with the Reynolds number range are given below:

$$C_D = 7.7 Re^{-0.813} \quad 0.007 < Re < 0.1, \pm 4\%$$

$$C_D = 10.48 Re^{-0.68} \quad 0.1 < Re < 2, \pm 4\%$$

$$C_D = 10.04 Re^{-0.738} \quad 0.007 < Re < 2, \pm 9.5\%$$

The above equations have been derived for L/D ratio of greater or equal to 90.

These equations can be used in calculating either the velocity of fall or the diameter of any fiber falling in any fluid (depending on their relative densities), as long as the physical constants of the fiber and the fluid are known.

Work should be directed towards hindered settling which finds many applications in paper industries and in the formation of non-woven viscose rayon textiles on paper machines. The latter process may some day replace the weaving process. 121 pages. \$2.00. Mic 57-2050

FLUID-PARTICLE HEAT TRANSFER IN PACKED BEDS

(Publication No. 21,270)

Ernest Bernard Baumeister, Ph.D.
Purdue University, 1957

Major Professor: C. O. Bennett

Experiments were carried out in a 4-inch I.D. transite tube packed with 3/8, 1/4, and 5/32-inch steel spheres. Average heat transfer coefficients between the spheres and air passing over them were calculated at flow rates of from 760 to 16,000 pounds per hour per square foot, and for 6 packings of the tube for each pellet size.

The results show that the ratio of D/D_p has a large influence on the heat transfer for the lowest values, and that above a ratio of about 18 this effect is quite small. These results are presented both graphically and in terms of empirical equations.

Point heat transfer coefficients are also calculated for various points across the radius at the entrance and exit of the bed. These coefficients increase near the wall where the mass velocity is greatest as expected. However, for the 1/4 and 5/32-inch pellets, the coefficients increase again near the center of the bed.

The analogies among heat, mass, and momentum transfer are discussed, and the results indicate that no simple relation exists between the heat transfer coefficient and the friction factor in the case of gases.

An attempt is made to predict the pressure drop

and heat transfer rates for packed beds from the data for single spheres.

158 pages. \$2.10. Mic 57-2051

VAPOR-LIQUID EQUILIBRIA OF LIGHT HYDROCARBON SYSTEMS CONTAINING HYDROGEN AT LOW TEMPERATURE

(Publication No. 21,145)

Alvin Lynn Benham, Ph.D.
University of Michigan, 1956

The purpose of this work was to complete the experimental vapor-liquid equilibria study of hydrogen-light hydrocarbon binary systems; to add to our knowledge of the behavior of hydrogen-light hydrocarbon ternary systems; to obtain some vapor-liquid equilibria data for a six-component hydrogen-light hydrocarbon system; and to correlate the data with the view of obtaining a generalized correlation from the study of binary and ternary systems.

Vapor-liquid equilibria data were obtained using vapor-recirculation type of equipment built to withstand pressure up to 10,000 lb/in.² Data were obtained for the hydrogen-methane binary system at temperatures of -150, -200 and -250°F and at pressures from 500 to 4000 lb/in.²; for the hydrogen-methane-propane ternary system at temperatures of 0, -100, and -200°F and at pressures of 500 and 1000 lb/in.²; for the hydrogen-methane-propylene system at -100°F and 500 lb/in.²; for the complex system containing hydrogen, methane, ethylene, ethane, propylene and propane for five sets of conditions including temperatures of 0 and -100°F and pressures of 500 and 1000 lb/in.²

A study was made of methods of correlating the equilibrium constants of hydrogen and light hydrocarbons as obtained from the experimental data reported in this thesis and from that reported in the literature.

The equilibrium constants for hydrogen in the hydrogen-methane system were correlated by a fugacity relationship previously used by R. B. Williams for correlation of other hydrogen binary systems.

The equilibrium constants for hydrogen in the hydrogen-methane-propane system were correlated as a function of the temperature, pressure, and the molal average boiling point of the liquid phase. By adding the vapor phase concentration of hydrogen to the correlation as a variable, it was found possible to obtain a correlation to describe the equilibrium constants in both the hydrogen-methane-propane system and in the hydrogen-methane-ethylene system described in the literature.

The equilibrium constants for methane in the hydrogen-methane-propane system were correlated as functions of the temperature, pressure and molal average boiling point of the liquid phase. By adding the molal average boiling point of the vapor phase variable, it was found possible to obtain a correlation to describe the equilibrium constants of methane in both the hydrogen-methane-propane system and in the hydrogen-methane-ethylene system reported in the literature.

Nomographic correlations of the equilibrium constants of ethylene, ethane, propylene and propane are given as functions of the temperature, pressure and the molal average boiling point of the liquid phase.

The six-component system of hydrogen, methane, ethylene, ethane, propylene and propane was not adequately described by the variables of temperature, pressure and the molal average boiling points of the vapor and liquid phases.

Since a further examination of methods of correlation using the temperature, pressure and two concentration variables did not uncover any satisfactory correlation of the six-component data with that of the binary and ternary systems, it has been asserted that at least one, and possibly two more, phase rule variables will be required.

140 pages. \$2.00. Mic 57-2052

A RAPID TECHNIQUE FOR DETERMINING SPECIFIC SURFACE IN LIQUID-LIQUID SPRAYS

(Publication No. 21,149)

Richard Henry Boll, Ph.D.
University of Michigan, 1955

The purpose of this study is to develop a light transmission technique for measuring the specific interfacial area produced in a liquid-liquid spray. Spray research has been hindered by lack of adequate analytical techniques. The new "one-shot" technique permits rapid analysis of liquid-liquid sprays and, thus, presents the possibility of extensive investigation of the effects of receiving fluid properties upon specific surface.

The one-shot technique is based upon a single measurement of the attenuation of a collimated, monochromatic, light beam passed vertically through the suspension resulting from the spray. An average value, \overline{RK}_t , is assigned to the RK_t -function which appears in the light transmission equation.

A detailed analysis is made of the optical system to determine what corrections need be applied to Gumprecht's R-function to account for the slight imperfections of actual lens-pinhole receivers. Up to 8 per cent correction is applied for the equipment used in this study. Equations and graphs are given for making the corrections for other equipment.

Values of the theoretical light scattering coefficient, K_t , are computed for values of relative refractive index of 0.8, 0.9, and 0.93 and values of α ranging from one to two-hundred. The results are correlated by a Lorenz-Lorentz type transformation permitting interpolation and slight extrapolation.

An average value, \overline{RK}_t , is assigned by assuming that \overline{RK}_t equals the value of the RK_t -function at the volume-surface mean drop diameter, D_{sm} . The accuracy of this assumption is investigated by calculating the true value of specific surface, S_p , and the value, S_p' , which would be obtained by the one-shot technique for several drop size distribution functions. It is found that up to 60 per cent error is possible with bimodal distributions. However, Nukiyama-Tanasawa distributions and others show errors up to only +10 per cent for S_p varying between 1000 and 10,000 cm⁻¹.

It is found that the range of applicability of the one-shot technique is limited by rapid settling of large drops which causes erroneous transmission data as the drops pack closely together on the bottom of the spray chamber. It is

estimated the value of the upper size limit is about $D_{sm} = 100$ microns. A lower limit of about $D_{sm} = 2$ microns is imposed by fluctuations in the value of the K_t function.

Qualitative observations for spraying water into ten receiving liquids reveal that no dispersion results if the viscosity of the receiving fluid is high enough (SAE 10 motor oil). "Double emulsions" are observed with certain receiving fluids.

Specific surface is determined as a function of flow rate for spraying water into benzene, carbon tetrachloride, and carbon disulphide. The ranges of the variables are: density of receiving fluid, ρ_c , from 0.87 to 1.58 gm/cm³; viscosity of receiving fluid, μ_c , from 0.34 to 0.89 centipoise; interfacial tension, γ , from 35 to 48 dynes/cm; flow rate, q , through the nozzle from 1.1 to 2.2 cm³/sec; fixed nozzle design, Kopp 0.75 gph, 60°HC (swirl chamber). Values of S_p range from 1700 to 3600 cm⁻¹. Several unsuccessful attempts to correlate these data are described. The successful correlation omits γ and μ_c :

$$(D_o S_p) = 0.0208 \left(\frac{q \rho_s}{\mu_s D_o} \right) + 73.7 \left(\frac{\rho_c}{\rho_s} \right) - 70,$$

where D_o is the orifice diameter, and ρ_s and μ_s are density and viscosity of the sprayed fluid, respectively.

The general conclusions drawn from this study are: (a) the new one-shot light transmission technique is practical, rapid, and accurate for measuring specific surface in liquid-liquid sprays; with slight modification it could be applied to liquid-in-gas sprays. (b) Gumprecht's R-function can and should be corrected for imperfections in actual lens-pinhole optical equipment. (c) Sprayed and receiving fluid variables are not separable in the correlation of specific surface with fluid properties. (d) The effects of flow rate and receiving fluid density are best expressed as additive terms in the correlation rather than product-power terms.

236 pages. \$3.05. Mic 57-2053

APPLICATION OF THE PRINCIPLE OF CORRESPONDING STATES FOR THE CORRELATION AND PREDICTION OF THE THERMODYNAMIC PROPERTIES OF PURE FLUIDS

(Publication No. 21,219)

Robert Albert Greenkorn, Ph.D.
The University of Wisconsin, 1957

Supervisor: Professor O. A. Hougen

In this investigation the principle of corresponding states is applied to the correlation of pVT data. A third parameter, the critical compressibility factor, has been added to improve the correlation. Values of the compressibility factor and reduced density were correlated with respect to reduced pressure, reduced temperature and the critical compressibility factor. (Reduction of variables unless otherwise mentioned are based on critical properties.) Vapor pressure and heat of vaporization data were also correlated in terms of the above parameters. Values of the enthalpy deviation, internal energy deviation, entropy deviation, heat capacity deviation ($p=\text{constant}$), fugacity coefficient and Joule-Thomson coefficient were

calculated from the correlated compressibility data by application of standard thermodynamics. The actual calculations of these derived properties were performed by application of numerical analysis and computing machine techniques. These data were correlated and smoothed through plotting. In addition a preliminary calculation and correlation of vaporization equilibrium constants was accomplished by using extrapolated fugacity coefficients. This correlation was also made in terms of reduced pressure, reduced temperature and the critical compressibility factor.

This investigation was undertaken to present an improvement over previous corresponding states correlations of pVT data by: (1) including the liquid region, (2) including the saturation envelope, (3) including a third parameter in the principle of corresponding states, (4) presenting a consistent calculation and correlation of the derived properties of major interest and (5) including available data for all types of compounds. (82 compounds were used in this correlation)

The correlations were accomplished by obtaining a set of plots representing the average of the data used. From these plots values of the derived properties were calculated using numerical and machine methods. The results are presented as plot and cross plot of each property. Tables of values are presented for compressibility factors, reduced density, enthalpy deviation, fugacity coefficient, entropy deviation, equilibrium constant and internal energy deviation. A table giving the saturated values of each of these properties is also included. Several tables of comparison of the derived properties with experimental data are given. A summary table of a complete check of compressibility factors with experiment (more than 4500 separate values were checked) is given. The error of the table as calculated from these points is 2.5% for the saturated region, 3.0% for the liquid region and 2.5% for the gas region. (This correlation includes all types of compounds from HCN to He, $z_c = 0.197$ to 0.304.) The reduced density correlation for the liquid region is an improvement over the compressibility factors. (Errors for the liquid density are of the order of 2.0%.)

This work shows a decided improvement over previous correlations and the use of a third parameter, the critical compressibility factor, has been justified. The tables and charts are presented for use in preliminary calculations, design calculations where exact data are not required or are not available, for extrapolation and interpolation of experimental data and as an aid for teaching thermodynamics.

261 pages. \$3.40. Mic 57-2054

VISCOSITY OF GASEOUS MIXTURES

(Publication No. 20,825)

Charles Albert Johnson, Ph.D.
Syracuse University, 1957

Supervisor: James A. Luker

This work was devoted to studying the availability of gas viscosity data at atmospheric and higher pressures and also to investigating proposed procedures for estimating such data.

It was found that a great number of measurements and correlations of gas viscosity data have been made but most of the work has been confined to single component gases at 1 atmosphere pressure. There has been a moderate amount of work done on pure gases at elevated pressures and also on binary mixtures at 1 atmosphere. Experimental studies of viscosities of binary mixtures at elevated pressures and multicomponent mixtures have been very rare.

Correlations are available for predicting the viscosities of pure gases at 1 atmosphere. An equation for mixture viscosities was derived by statistical mechanics which gives very good results but which requires tedious calculations. The only practical way to estimate the effect of pressure on the viscosities of pure gases is to use one of the generalized viscosity charts. There is no procedure suggested in the literature for calculating the viscosities of mixtures at elevated pressures.

In this work an existing mixture viscosity equation was modified empirically to give an equation to calculate the low pressure values more easily. The resultant equation was compared with experimental data obtained from the literature on four binary mixtures. The agreement was not as good as with the statistical mechanical equation but the computations were far less time consuming.

Then the low pressure equation and the statistical mechanical equation were modified to predict viscosities of mixtures at elevated pressures. Since experimental data on mixtures above 1 atmosphere are very sparse, a steady-flow type capillary was built and data were measured on oxygen, helium, three oxygen-helium mixtures, a steam-helium mixture, and a steam-oxygen mixture for comparison with the calculated data. The experimental results were accurate to approximately $\pm 1\%$. The accompanying table shows the accuracies with which the equations predicted the viscosity data. Comparisons were also made for a nitrogen-methane binary and air for which experimental data are available in the literature.

Mixture	Proposed Equation	Modified Stat. Mech. Equation
Helium-Oxygen	2%	3%
Steam-Oxygen	2%	1%
Steam-Helium	3%	12%
Methane-Nitrogen	4%	2%
Air	3%	0

It was concluded from this work that the measurement of gas viscosity data is a difficult task which should only be undertaken when estimation of the data is impossible. Techniques are now available whereby viscosity data for most mixtures can be estimated at conditions ordinarily encountered.

129 pages. \$2.00. Mic 57-2055

SOLUTION OF DIFFERENTIAL EQUATIONS DESCRIBING TRANSIENT BEHAVIOR OF DISTILLATION EQUIPMENT

(Publication No. 20,941)

Paul Gust Lafyatis, Ph.D.
Case Institute of Technology, 1956

Transient behavior of a distillation column is described by a series of simultaneous non-linear differential equations. The complete mathematical solution of problems involving these equations is not always possible. They can generally be solved with the aid of computing machines such as analog computers.

The differential equations necessary to describe the transient behavior of a bubble-cap plate column following a change in feed composition to this column have been developed and solved. The equations form a set of simultaneous non-linear differential equations. The nonlinearities of the system are introduced by the equilibrium existing between the vapor composition and the liquid composition on each plate. In a distillation column this is a function of the chemical system being distilled.

Columns containing few plates may be simulated with a separate function generator for each plate. In the approach used herein a single function generator representing multiple equilibria involved on many plates as a function of the system is used on a time-shared basis to provide data for each circuit of the column analog as needed. A column analog was developed on a Model L-3 Goodyear Electronic Differential Analyzer (G.E.D.A.) and function generators were constructed to represent an idealized system obeying Henry's Law and the real system benzene-toluene. Test problems involving these systems were solved.

60 pages. \$2.00. Mic 57-2056

THE EFFECT OF SUPERATMOSPHERIC PRESSURES ON NUCLEATE BOILING

(Publication No. 21,337)

Russell Bernard Mesler, Ph.D.
University of Michigan, 1956

This dissertation treats the effect of superatmospheric pressure on the relationship between the heat flux and the difference between the surface and the liquid-saturation temperatures in nucleate boiling of organic liquids. At atmospheric pressure the temperature difference is in the range of from 30 to 60° F. while at pressures above 365 lbs/sq in. the difference is less than 10° F. However, a pressure difference defined as the difference between the vapor pressure of the liquid at the temperature of the surface minus the saturated pressure shows much less variation over the same range. A study of such a pressure difference was made to determine whether its behavior is the same for organic liquids belonging to distinctly different classes of organic compounds.

To make a more detailed study than permitted by available data, an apparatus was built to obtain additional data. The boiling surface was the outside surface of a 0.0643-in. diameter, stainless steel, electrically heated tube. Data were obtained for acetone, benzene, ethanol, and Freon 113

at pressures from atmospheric to 515 lbs/sq in. abs. The range of heat flux studied was from 10,000 to 60,000 BTU/(hr)(sq ft).

An examination of the nucleate boiling data revealed that the data are well represented by straight lines on a linear plot of heat flux versus the surface liquid-saturation temperature difference. Furthermore, the effect of increased pressure is to shift these lines to lower temperature differences without materially changing the slopes of the lines. These lines have reciprocal slopes in the range of from 5 to 20° F. per 100,000 BTU/(hr)(sq ft). The reciprocal slope depends somewhat on the liquid, but an average value is about 10.

To separate the effect of pressure and heat flux on the temperature difference, the lines were extrapolated to zero heat flux. The pressure difference between the vapor pressure of the liquid at this extrapolated surface temperature and the saturated pressure was examined. This pressure difference was found to behave in the same manner for all the liquids investigated, and the behavior apparently applies for other organic liquids. The pressure difference increases about 20 per cent from atmospheric to 100 lbs/sq in. abs and then decreases, apparently to zero at the critical point.

Using this behavior and a reciprocal slope of 10° F. per 100,000 BTU/(hr)(sq ft) the superatmospheric pressure data for n-pentane were predicted and compared with data from the literature (10). The predicted data agree with the experimental data to within 2° F.

The effect of superatmospheric pressure on the appearance of nucleate boiling is to make the bubbles smaller. Above 365 lbs/sq in. abs the bubbles are almost too small to be seen individually. 145 pages. \$2.00. Mic 57-2057

ANALYSIS OF HEAT TRANSFER AND OF MASS TRANSFER IN TURBULENT STREAMS

(Publication No. 21,121)

John Francis Pardo, Ph.D.
Columbia University, 1955

The problem of heat transfer and material transfer in turbulent streams is considered, first from a general standpoint, then with a view to obtaining a specific solution. The Fourier-Poisson equation and its mass transfer equivalent are studied and noted to be of little assistance as such in turbulent flow. A statistical version of the equation is obtained by submitting it more systematically than is usually done to an averaging process originally adopted by Osborne Reynolds to derive his "equations of mean-mean motion." This version, which involves temporal-mean quantities at a point, is here discussed under the name of "equation of mean-mean transfer in the statistically-steady state." The question of reducing it to a differential relationship purely among the dependent temperature (or concentration) variable and the position variables is examined.

During the remainder of the study, attention remains principally focused on the case of a fully developed turbulent stream within a smooth circular pipe, a portion of which is conditioned to provide or withdraw either heat or foreign substance. While the equation of mean-mean transfer simplifies a great deal in such a case, especially if the

eddy conductivity (or diffusivity) concept is invoked, the two-dimensional integration which it requires is not feasible by analytical means. In nearly all previous treatments, the problem has been reduced to a one-dimensional integration by postulating a distribution for the radial heat (or diffusional) flux. Even at their best, such analyses furnish no information on the entrance evolution of the temperature (or concentration) profile.

A finite difference method is presented here for carrying out the integration two-dimensionally, under a variety of boundary conditions. The finite difference computation is greatly expedited by means of an electric analog designed and built for the purpose. This analog involves only resistances, which makes for a simple, inexpensive and accurate circuit. It must be operated stepwise, from one voltage profile to the next, but good stability characteristics allow the steps to be taken relatively large. Such stepwise operation has a distinct advantage whenever the coefficients of the transfer equation need to be varied as the computation proceeds. It also has the advantage, with this particular circuit, of permitting the application of a simple integrating device, capable of furnishing at any stage what corresponds to the local mixed-mean temperature (or concentration) of the stream.

After a number of preliminary computations to test this technique, the above-mentioned flow case is treated for the boundary condition of uniform supply of heat (or foreign substance) along the wall of the pipe. Necessary information as to the profile of eddy conductivity (or diffusivity) is obtained from experimental sources, and the seventh power law adopted for the velocity profile. Prior to actual solution by the analog, the transfer equation is conveniently rearranged to involve a single dimensionless parameter P , function of Reynolds and Prandtl (or Schmidt) number; this causes the solution, in the terms chosen, to depend just on P instead of separate dependences on these two numbers. Obtained for each of several values of P is the entrance evolution of the temporal-mean temperature (or concentration) profile and, among other by-products, the entrance variation of the local individual transfer coefficient T . Results are presented graphically and point to a number of interesting conclusions as to the effect of P . Their scope is limited to the extent of having assumed no effect of temperature (or concentration) differences on the flow and no conduction (or diffusion) in the general direction of flow. 230 pages. \$3.00. Mic 57-2058

A STUDY OF THE VOLUMETRIC PROPERTIES AND THERMAL STABILITY OF CONCENTRATED NITRIC ACID

(Publication No. 21,451)

Manoj Kumar Dalichand Sanghvi, Ph.D.
The Ohio State University, 1956

The phase relations of the binary and ternary mixtures of nitric acid with nitrogen dioxide and water, containing up to 30 per cent by weight of nitrogen dioxide and 10 per cent by weight of water, were determined over the temperature range from 85° to 150°C. and a range of V^G/V (ratio of the vapor volume to the total volume of the sample) from approximately the bubble point to 0.8. For this purpose, a

small sample of a mixture of known composition was maintained under isothermal and isochoric conditions in a glass tube, and measurements of the pressure were made at regular intervals of time until physical and chemical equilibria were reached. The reversibility of the decomposition reaction was established, and the effects of the V^G/V ratio, the temperature, and the amounts of nitrogen dioxide and water on the pressure were determined within the stated ranges.

The pressure, which is primarily due to the oxygen formed as a result of the decomposition, increases with an increase in temperature and with a decrease in the V^G/V ratio.

The pressure is markedly reduced by the addition of nitrogen dioxide and (or) water, particularly at the lower temperatures. On a weight basis, water is more effective in reducing the pressure than nitrogen dioxide.

The V^G/V ratio has a very great influence on the value of the equilibrium pressure of mixtures high in nitric acid content, but this influence diminishes with the addition of nitrogen dioxide and water, and becomes relatively insignificant in mixtures containing more than 20 per cent of additive (nitrogen dioxide plus water).

The effect of temperature on the equilibrium pressure for a given V^G/V ratio depends on the proportion of nitrogen dioxide in the additive. In the case of nitric acid-water mixtures, the equilibrium pressure decreases with increasing water content at all temperatures and all V^G/V ratios studied, whereas in the case of the nitric acid-nitrogen dioxide mixtures at temperatures above 125°C. and for V^G/V ratios greater than 0.6, the equilibrium pressure is found to increase with the addition of nitrogen dioxide.

The rates of attainment of equilibrium are increased by the addition of nitrogen dioxide and decreased by the addition of water. When nitrogen dioxide and water are added in a fixed ratio, the rate constants first show a decrease, pass through a minimum at about 10 per cent of the additive, and then increase with a further increase in the additive.

The rates are increased by a decrease in the V^G/V ratio or by an increase in temperature. The value of the rate constant at the bubble point is approximately twice that for a V^G/V ratio of 0.5, and four times that for a V^G/V ratio of approximately 1.0. The rate of decomposition at 105°C. is nearly 25 times the rate at 76°C. This corresponds to a value of about 30 k.cal./mole for the apparent energy of activation.

The results of the investigation are presented in both graphic and tabular form from which an estimate can be made of the pressure-time relationship under isochoric conditions for a mixture of given initial composition in the range of 78-100 per cent nitric acid, 0-22 per cent nitrogen dioxide, and 0-10 per cent water at any temperature between 25° and 150°C. and for a V^G/V ratio between 0.15 and 0.60. The corresponding specific volume of the heterogeneous mixture at physicochemical equilibrium can also be estimated.

259 pages. \$3.35. Mic 57-2059

A STUDY OF THE RATE FACTORS IN VAPOR-PHASE SOLID-CATALYZED DECOMPOSITION OF n-HEXYL ACETATE

(Publication No. 21,496)

Thomas Fujio Sashihara, Ph.D.
The Ohio State University, 1957

The vapor-phase decomposition of n-hexyl acetate to acetic acid and 1-hexene with metal oxide on bauxite catalysts was investigated at 255° C. and 305° C. over a range of pressures from one to four atmospheres and with catalyst to feed rate ratios of 12.3 to 1250 grams of catalyst per gram mole of ester feed per hour. Conversions ranged from 7.3 to 85 per cent.

The experiments were carried out in a steady state equilibrium flow reactor. Each reaction was conducted at constant feed rate, temperature, and pressure; the resultant integral conversion was measured.

The investigation was conducted in two parts: a preliminary catalyst study was made with the oxides of boron, molybdenum, cerium, thorium, and manganese on bauxite to test the effect of each oxide on the catalytic activity and stability of bauxite; and a second study was conducted with boric oxide on bauxite catalyst to test rate correlating methods.

It was found from the preliminary study at 255° C. that the relative activities for the oxides of the following metals, referred to bauxite, were: boron, 3.6; molybdenum, 1.7; cerium, 0.12; thorium, 0.10; and zirconium, 0.007. Each catalyst showed decay in activity ranging from 2.6 to 9.2 per cent per hour. At 305° C. the relative activities for the oxides of the following metals, referred to bauxite, were: boron, 3.2; chromium, 0.7; and manganese, 0.18. Catalyst activity decay at this temperature ranged from 0.2 to 0.9 per cent per hour. Temperature coefficients based on the activity at 255° C. were: for untreated bauxite, 7.7; for the oxides of the following metals on bauxite, boron, 6.3; chromium, 10; and manganese, 4.7.

The study of this reaction on boric oxide at 305° C. indicates that a discontinuous catalyst activity decay correction is suitable. Correlation of the rates with the Langmuir-Hinshelwood mechanism was poor. However, a good correlation of the rates was obtained when the Langmuir isotherm term for the ester was replaced by an empirical term in the dual-site surface reaction rate-controlling Langmuir-Hinshelwood mechanism. The empirical isotherm is:

$$c_E = \frac{\pi_E}{\pi_E - \pi} K_{E_0} a_E;$$

where c_E is the concentration of adsorbed ester in gram moles per gram of adsorbent; π_E is the saturation pressure of the ester; π is the total system pressure; K_{E_0} is a constant; and a_E is the activity of the ester in the vapor at the solid interface. The resultant correlating equation is:

$$r = \frac{k' \left(\frac{\pi_E}{\pi_E - \pi} \right) K_{E_0} a_E}{\left[1 + \left(\frac{\pi_E}{\pi_E - \pi} \right) K_{E_0} a_E + K_{O_2} a_{O_2} + K_A a_A \right]^2}$$

where r is the rate of reaction in gram moles of ester

converted per hour per gram of catalyst; k' is a constant; K_O and K_A are the Langmuir adsorption equilibrium constants for the olefin and acid respectively; and a_O and a_A are the activities of the olefin and acid, respectively, in the vapor at the solid interface. Values for these constants at 305° C. were π_E , 6.57; k' , 0.294; K_{E_O} , 0.501; K_O , 0.0521; and K_A , 5.01.

This correlation holds within an average deviation of ± 4.6 per cent for a range in feed compositions of 4 : 1 ratio of olefin to ester to a 1 : 1 ratio of ester to acid at atmospheric pressure, and for pure ester feed up to four atmospheres. This correlation was tested for a range of conversions from 7.3 to 60 per cent.

157 pages. \$2.10. Mic 57-2060

THE EXTRACTION OF COBALT AND NICKEL NITRATES FROM AQUEOUS SOLUTION BY ORGANIC SOLVENTS

(Publication No. 21,497)

Edward Jonathan Scharf, Ph.D.
The Ohio State University, 1957

The separation of cobalt and nickel has long been of commercial and academic importance. In recent years, considerable interest has been shown in the use of liquid-liquid extraction to separate mixtures of inorganic compounds. Detailed studies concerning the extraction of the sulfates and the chlorides of cobalt and nickel have been reported. Good separation of cobalt and nickel was obtained by extraction of the chlorides. Separation in the sulfate system was poor. The nitrates of cobalt and nickel could easily be formed by the nitric acid leaching of ores, concentrates, and in-process materials containing the two metals. Therefore, an investigation was carried out to study the use of liquid-liquid extraction as a method of separating cobalt and nickel nitrates. In addition, it was hoped that the investigation would add to the fundamental knowledge of extraction relationships of systems containing inorganic compounds.

The first series of tests was made to determine the distribution data for the pure metal nitrates between water and a variety of organic solvents at 25.0° C. In these tests each metal was equilibrated separately, and the effects of several foreign electrolytes on its distribution characteristics were determined. Distribution runs were then carried out with the best solvent.

The distribution of cobalt nitrate or nickel nitrate between water and organic solvents was generally low in all cases. Distribution coefficients in favor of the organic phase ranged from 10^{-2} to 10^{-5} . Alcohols were the best extractants for both cobalt and nickel. Foreign electrolytes did not appreciably change distribution characteristics. Foreign nitrates, including nitric acid, increased distribution slightly at low metal concentrations. However, as metal concentration increased, the distribution approached that obtained when no additive was present or fell below that value. Foreign chlorides generally decreased extraction of both metals. No appreciable separation of cobalt and nickel was gained by the use of any of the additives.

Normal butanol was chosen in conjunction with nitric

acid to determine extraction characteristics with cobalt and nickel nitrates. Distribution coefficients with n-butanol were higher than those for any of the other solvents used. The study of the effects of nitric acid on distribution afforded a comparison with other investigations where cobalt and nickel had been extracted in the presence of inorganic acids. When each metal was equilibrated separately at 25.0° C., distribution coefficients were on the order of magnitude of 10^{-1} to 10^{-2} . Distribution increased with increasing metal concentration. It was also found to depend on the total content of cobalt and nickel in the aqueous phase. Increasing nitric acid concentration increased distribution slightly at low metal concentrations. At high metal concentrations, increasing acid concentration decreased extraction of the metals. This trend was unlike that found in the sulfate and chloride systems of cobalt and nickel, where the corresponding inorganic acids were quite beneficial to extraction. Separation factors were low, and varied with both acid and metal concentration. Maximum cobalt-to-nickel separation factors were about 1.5 when the metals were equilibrated without additives. Nitric acid decreased the separation slightly. The distribution of both metals decreased somewhat with increasing temperature.

It was concluded from the experimental work that the separation of cobalt and nickel nitrates by liquid-liquid extraction is not commercially feasible. This conclusion was reached on the basis of the distribution of the metal nitrates with a variety of organic solvents. Distribution coefficients in favor of the organic phase were generally low. The addition of foreign electrolytes did not favorably affect the distribution characteristics. Calculations based on data obtained with n-butanol showed that some separation of cobalt and nickel nitrates could be gained by liquid-liquid extraction. However, such large volumes of solvent would be required that the cost of such an operation would be prohibitive.

151 pages. \$2.00. Mic 57-2061

PHASE EQUILIBRIUM IN SYSTEMS WITH SUPERCRITICAL CARBON DIOXIDE

(Publication No. 20,156)

Robert Audley Snedeker, Ph.D.
Princeton University, 1956

For abstract, see page 1233.

131 pages. \$2.00. Mic 57-1978

A STUDY OF THE MINERAL CONSTITUTION AND CERAMIC PROPERTIES OF SOME SHALES FROM PENNSYLVANIA

(Publication No. 20,979)

Willard Holmes Sutton, Ph.D.
The Pennsylvania State University, 1957

The object of this study was to investigate the mineralogical constitution and ceramic properties of four natural brick-making shales, and to make correlations, wherever possible, between properties and mineralogy. Since the

clay minerals determine to a large extent the ceramic properties, it was necessary to segregate them partially from the coarser non-clay minerals by careful fractionation of the shales into five grain-size ranges: $>44\mu$, $44-10\mu$, $10-1\mu$, $1-0.3\mu$ and $<0.3\mu$ ($1\mu = 10^{-4}$ cm.), using sedimentation and supercentrifugation methods.

In addition to the four natural shales, seven samples were made by appropriate recombination of the size fractions so that they would have approximately the same particle-size distribution. This minimized the effects of different particle-size distributions and accentuated those due to different mineral contents. The plastic, dry, and fired properties (transverse strength, dimensional changes, weight loss, bulk density, and color changes) of the four shales and seven samples were then investigated.

The mineral constitution of the shales and size fractions was determined from the combined results of optical and electron microscopy, chemical and X-ray fluorescent methods, X-ray diffraction and differential thermal analyses. It was found that quartz, mica, and hydrous mica accounted for 90% of the total weight of each of the natural shales; the remaining 10% consisted of chlorite, goethite, haematite, and traces of TiO_2 and organic impurities. The principal clay mineral (hydrous mica) crystallized as a 2-layer monoclinic (2M) mica-type polymorph.

The results showed that there are three temperature ranges with respect to which the ceramic properties can be considered:

110°-600°C – properties such as weight loss, strength and shrinkage were affected by oxidation of organic materials, decomposition and oxidation of iron compounds, and decomposition of the clay minerals. These properties are partly dependent on forming techniques and on mineral composition. The properties of the natural shales indicate that particle-size distribution is also important.

600°-800°C – properties change very little in this temperature region.

800°-1100°C – properties are greatly affected by vitrification; strength, volume contraction and bulk density increased markedly. If at higher temperatures (e.g. 1100°C) over-vitrification and bloating occurred, samples expanded and were much weaker. Chemical composition, rather than mineralogical composition, plays a more important role, e.g., the amount of K_2O is more important than the type of mica polymorph containing the K_2O . Since the fired properties of the samples with similar grain-size distributions were very similar to those of the natural shales from which they were made, it seems likely that chemical composition is also more important than particle-size distribution.

Although there were notable differences between the properties of the natural shales and samples, too many factors were involved for detailed correlations to be made between observed properties and the mineral composition. For example, there appeared to be no general relationship between strength and clay content.

Acid treatment, which removed organic impurities and

iron bearing minerals, produced essentially two effects: the strength of specimens fired to low temperatures became considerably weaker, and specimens fired to high temperatures (1100°) showed no tendency to overvitrify and bloat, as did the untreated ones.

The initial color of the shales was determined essentially by the amount and type of iron minerals present. Samples rich in goethite ($\text{FeO}\cdot\text{OH}$) were yellow while those rich in haematite (Fe_2O_3) were red. Acid-treated samples, containing no goethite or haematite, were white.

134 pages. \$2.00. Mic 57-2063

LOCAL RATES OF MASS TRANSFER IN A PACKED BED OF SPHERES, WITH ORIFICE ENTRY OF AIR

(Publication No. 19,722)

Charles Manson Thatcher, Ph.D.
University of Michigan, 1955

Local rates of mass transfer in a packed bed were determined by measuring the loss in weight of individual spherical pellets of p-dibromobenzene, carefully positioned in an otherwise inert bed of spheres through which a stream of air was passed.

The tests were made in a cylindrical bed 4 inches in diameter, measurements being made to within 1/32 inch from the wall, with packing diameters of 1/8, 1/4, and 1/2 inch, and covered a Reynolds number range of $150 < D_p G / \mu < 7,000$. Measurements were also made with the air entering the bed through 1- and 2-inch orifices, to determine the effect of the resulting velocity perturbations on mass-transfer rates.

The experimental equipment consisted of an air-supply system capable of supplying air at a temperature of approximately 80°F and at rates ranging from 10 to 120 standard cubic feet per minute, and a packed test section which could be quickly detached from the air-supply line to facilitate the loading and recovery of the active pellets.

Measured weight losses were first corrected for minor fluctuations in air temperature and for the loss attributable to exposure to the atmosphere during the loading and recovery operations, and were then converted to mass-transfer rates by introducing the surface area of the pellets and the running time over which the weight loss was incurred.

Within the scope of the investigation, it was found that local rates of mass transfer in a packed bed could be correlated by the general equation

$$k'/G' \times 10^6 = B \left(\frac{D_p G}{\mu} \right)^m, \quad (1)$$

where k' is the transfer rate in pound-mols per square foot of surface per hour, G is the superficial mass velocity (prime denotes molal units), D_p is the packing diameter, μ the viscosity of air, and B and m generally depend on position within the bed and orifice diameter, but are independent of air flow rate and packing diameter.

When no orifice was used, entrance effects were observed only in the first 1/2 inch of bed depth, where the

transfer rates were slightly higher than elsewhere. The rates were found to be independent of radius at all depths, however.

With an orifice across the entrance to the bed, the exponent in Equation (1) is independent of orifice diameter and position in the bed, and is equal to -0.35. B, on the other hand, varies with both of these parameters. Transfer rates as much as 300 per cent higher than elsewhere were observed in the vicinity of the orifice, but the perturbations created by the orifice are completely dissipated at a bed depth of approximately 2 inches.

The nature of the data does not permit direct comparison with the results of previous investigations of overall mass-transfer rates in packed beds. By making certain assumptions, however, a limited comparison is possible and indicates that the present correlation may be high by a factor of approximately two. Despite this lack of agreement, the relative effects of pellet diameter, air flow rate, position in the bed, and orifice diameter on local rates of mass transfer are believed to be correctly delineated.

231 pages. \$3.00. Mic 57-2064

THE CREEP-RUPTURE LIFE AT UNIFORM ELEVATED TEMPERATURE OF ENGINEERING STRUCTURES WITH AN INITIAL STRESS GRADIENT

(Publication No. 21,368)

Howard Robert Voorhees, Ph.D.
University of Michigan, 1956

Many engineering structures used under creep conditions are characterized by an initial concentrated stress, often of complex pattern. Two examples - internal-pressure vessels with high ratio of wall thickness to diameter and notched tension members - have been studied experimentally and analytically. Attempts have been made to correlate creep-rupture life of structures in terms of conventional creep-rupture properties for simple tension under uniform stress.

Limited experimental data were obtained on rupture of vessels under internal pressure for five conditions of alloy and temperature, with ratios of outside diameter/ inside diameter as high as 3.0 for one material and up to 2.0 for three other conditions. Extensive rupture tests on round and flat notched tension specimens were conducted with five alloys.

At elevated temperature a high stress requires a corresponding rapid rate of plastic deformation with time. If the stress is localized so that gross movement of the structure is restricted, local creep must act internally to replace initial elastic stresses, with consequent lowering or "relaxation" of the initial peak stresses.

Rupture life of the structure should be predictable from a knowledge of such stress changes with time if one knows how to predict the rupture behavior under variable stress.

Creep-rupture tests with alloys of varied type were carried out on smooth tension specimens under constant axial load, and with the load altered from one constant level to another in the course of the test. For alloys at temperatures where they are metallurgically stable, the portion of total rupture life used up during a period at a

given stress in a variable-stress test was found to equal the fraction:

$$\frac{\text{actual time at the given stress}}{\text{rupture life at that stress}}$$

Moreover, for a constant test temperature the creep rate at any time in a variable-stress test seemed to depend only on the stress acting at the moment and on the cumulative fraction of life expended, independent of the past creep history.

A step-wise calculation procedure was developed based on these findings, assuming creep rupture to be controlled by the shear stress invariant theory of failure. Calculated results showed qualitative agreement with test findings in all cases.

Conclusions drawn included the following:

1. Rupture life of a structure with an initial concentrated stress appears to be completely explainable in terms of three factors:

- a.) The initial distribution of stress, determined by the geometry of the system, the applied load and the stress-strain properties of the alloy as tested.
- b.) The rate of redistribution of initial stress gradients, as controlled by creep relaxation.
- c.) Rupture characteristics of the material at the variable prevailing stresses and for the prior history experienced by different fibers in the structure.

For some alloys a small amount of plastic deformation at the location of stress concentration when the structure is loaded may alter subsequent creep-rupture characteristics. Allowance for such property changes is assumed under (b.) and (c.).

2. It appears that rupture life of a structure in the presence of a concentrated complex stress involves no new factors beyond those which determine rupture under simple stressing. If one can predict the stress-strain-time histories at points throughout a body, the time until rupture at any point seems amenable to calculation from data obtained with conventional smooth tension specimens.

3. The majority of data obtained suggest the effective stress of the shear stress invariant theory as a proper measure of the stress controlling creep rupture, but the evidence is inconclusive. A critical need exists for a definitive demonstration of the combination of stresses and/or strains which determines rupture life of ductile metals following complex-stress creep histories.

199 pages. \$2.60. Mic 57-2065

A STUDY ON THE CONTINUOUS COUNTER-CURRENT DIFFUSION OF BEET SUGAR

(Publication No. 18,663)

Hung Han Yang, Ph.D.
University of Michigan, 1956

A continuous counter-current diffuser for the extraction of beet sugar with water was constructed. The sugar beets were processed at 65-60°C and with 1.0-1.2 pound diffusion water per pound beet. For Michigan beets, the optimum operating conditions in the continuous diffuser were determined to be 75°C and 1.0 diffusion water per pound beet. A comparative study between the normal continuous, continuous with chemically pretreated cossettes, and the batch processes was made. On the basis of apparent purity, content of impurities, and color of diffusion juice, draft, and recovery of sugar, the continuous process compared favorably with the other processes. Continuous process with cossettes pretreated by aluminum sulfate, however, is worthy of further investigation on account of the low content of impurities and light color of the diffusion juice.

The diffusion rates of beet sugar in the continuous diffuser under various operating conditions were obtained. Such data were correlated in terms of the fractional extractable sugar content of beet as a function of diffusion water rate, temperature, and diffusion time. The generalized correlation provided a simple and useful application to the design of commercial continuous diffusers.

Inasmuch as the extraction of beet sugar was treated as a diffusion process, it was possible to correlate the instantaneous diffusion rates obtained by a semi-batch method on the basis of the fractional extractable sugar content of beet vs. diffusion time. A method of integrating the instantaneous diffusion rate data under presumed operating conditions in a commercial continuous diffuser was established. In two sample calculations, the integrated instantaneous diffusion curves showed close agreement with the experimental continuous diffusion curves.

The effect of the thickness of cossettes on diffusion rate was also studied by the semi-batch diffusion method.

The semi-batch diffusion data, as a whole, showed that the extraction of beet sugar does not follow the simple diffusion theory, which is true for the diffusion of a solute through an uniformly porous solid. The deviation is attributed to the natural structure of beet cells, and the combined effect of mixing of sugar juice in the ruptured cells with diffusion water and diffusion of sugar juice through the cell membrane in the initial stage of extraction process.

The semi-batch diffusion method, however, proved to be a simple but efficient experimental procedure to study the diffusional behavior of any solute through porous solid.

169 pages. \$2.25. Mic 57-2066

CHARACTERISTICS OF AIR POCKETS IN FLUIDIZED BEDS

(Publication No. 21,212)

George Yasui, Ph.D.
University of Washington, 1957

The characteristics of air pockets in beds of fluidized solids were determined using light probes to detect the bubbles. Based on the light transmission principle, the method developed consisted of the use of two pairs of light sources and light sensing elements, the signals from which were converted to electrical impulses, amplified, and recorded on oscillograms. Measurement of the signal traces yielded data on the average thickness, rise speed, and frequency of detected bubbles.

The experiments were conducted at room temperature and atmospheric pressure. Air was used to fluidize four sizes and two mixed sizes of glass beads, three sizes of a crushed magnesium silicate rock, a few commercial catalysts, coal, and hollow resin spheres. Bed depths at minimum fluidization ranged from 1 to 2.5 ft. With one exception all the data were taken with the sensing elements of the probe at the axes of the 4- and 6-inch I.D. Pyrex columns. For the most part representing values of mass velocity from 1.5 to 2.5 times minimum fluidization velocity, the superficial linear velocities ranged from 0.02 to 1.2 ft. per second. The range of average particle diameters based on permeability measurements was from 12 microns for a fluid catalytic cracking catalyst to 450 microns for coal; the lightest material was hollow resin with a particle density of 21 lb. per cu. ft., while the heaviest material was magnetite having a particle density of 304 lb. per cu. ft. The light probe locations ranged from 5 to 25 inches above the support of the fluidized bed.

Preliminary investigations were made of the effect of types of bed support, probe spacing, and size mixtures of glass beads.

In general the results were found to quantitatively support the qualitative observations of previous workers on the properties of fluidized systems. Empirical equations are given for the correlation of the average bubble thickness as a function of particle diameter and air flow rate. Rise speed and frequency of bubbles were not amenable to definitive correlations, being rather insensitive to the operating variables investigated and appearing to be inconsistent in trend from material to material. Most of the data for rise speed fell in the region between one and two ft. per second. The maximum frequency of the air bubbles detected was about three per second. The data indicated that gas bubbles in fluidized beds coalesce and grow in size while rising up through the solids. With some qualifications the results tend to support the theory of two-phase fluidization.

By providing quantitative values of the characteristics of air bubbles in fluidized beds, the results of the experiments are believed to furnish basic information relative to gas bubble formation and the mechanism of fluidization which may be useful in the study of reaction kinetics and heat and mass transfers in systems of air-fluidized solids.

187 pages. \$2.45. Mic 57-2067

ENGINEERING, CIVIL

THE BUCKLING OF THIN CYLINDRICAL
SHELLS WITH EQUALLY SPACED STIFFENING
RINGS UNDER UNIFORM EXTERNAL PRESSURE

(Publication No. 21,268)

Hossein Bahiman, Ph.D.
Purdue University, 1957

Major Professor: Dr. John E. Goldberg

This thesis is concerned with the determination of the critical value of the uniform external pressure for an infinitely long, thin, cylindrical shell with evenly spaced reinforcing rings. The study is restricted to those buckling modes in which the stiffening rings, together with the shell segments between them, have an identical deflection form; that is, the deflected shape is symmetrical about the plane of any ring.

The approach used in this thesis for the solution of the above problem considers the three radial, tangential and axial displacements as the generalized coordinates. In this method of approach, the total potential energy is minimized and then displacement patterns are prescribed as the products of a trigonometric function in the circumferential direction and an exponential function whose exponent is the product of a parameter and the longitudinal coordinate. In this manner the problem is resolved into a set of three linear, ordinary, homogeneous equations in terms of the three basic displacements in which the coefficients of the equations are functions of the load and of the above-mentioned parameters. For a non-trivial solution, the coefficient determinant must be zero. Hence, selecting a specific value for the load, a fourth order equation in the square of the parameter derived from the characteristic equation is obtained. Each of the roots of the characteristic equation corresponds to a mode of displacement. Each displacement mode must be multiplied by a constant and then the products are totalled. Application of the boundary conditions will lead to the evaluation of these constants. In addition to the geometrical boundary conditions, there are two statical boundary conditions, which are given by the expressions of the shell displacements at the edge in terms of the radial and tangential shears. By equating the displacements of the shell segment at the edge and those of the rings, a set of linear, homogeneous equations in terms of the two radial and tangential shears will be obtained. For non vanishing values of the shears, the determinant of the coefficients must be equal to zero.

Finally, an example has been worked out which shows that the buckling pressure is about 11 percent smaller than the value given by von Mises' formula.

62 pages. \$2.00. Mic 57-2068

DESIGN AND ANALYSES OF TALL TAPERED
REINFORCED CONCRETE CHIMNEYS
SUBJECTED TO EARTHQUAKE

(Publication No. 21,137)

Nelson Mijares Isada, Ph.D.
University of Michigan, 1956

The object of this study is to formulate rational and orderly rules to be followed in the design and analyses of tall tapered reinforced concrete chimneys on rigid foundations as determined by earthquake stresses.

The study is divided into four major phases, namely:

- (1) The accumulation of accelerogram records and a decision to use the records taken at El Centro, California on May 18, 1940 with N-S component, Vernon, California on October 2, 1933 with NO8E component, and Los Angeles Subway Terminal on October 2, 1933 with N39E component,
- (2) the accumulation of experimental results on the coefficient of damping and a decision to use 5% and 7-1/2% of critical damping for each mode,
- (3) the development of the dynamic analyses, divided as follows:

a. Derivation of the instantaneous displacement, shear, and bending moment equations along the height of the chimney by the use of Lagrange's equations. These equations are expressed as the sum of the effects of the various modes of vibration.

b. Determination of the fundamental mode dynamic structural properties of the chimney by the use of the Stodola-Newmark method. These properties are the vibration mode shapes, shear factors, moment factors, natural frequencies, and the generalized co-ordinate factors. The effects of damping in these properties are also discussed.

c. Determination of the second and higher mode dynamic structural properties of the chimney. This part requires the use of the orthogonality relationship of the various modes.

d. Solution of the generalized co-ordinate differential equations for each mode. The Laplace transform and Newmark's step by step methods are summarized. However, in this study the electronic analogue computer is used.

e. Determination of the design shears and bending moments. Here the instantaneous shears and bending moments are computed from the results of the different steps above.

f. Determination of the magnification factors. First, the shears and bending moments are determined by the use of empirical seismic coefficient K_e for a particular locality. This seismic coefficient is multiplied by the weight of the chimney above the section under consideration to get the forces acting on the chimney. Then the maximum shears and bending moments as obtained from the dynamic analysis in step e are divided by the corresponding shears and bending moments as obtained by the $W'/g K_{eg}$ method to get the magnification factors. These magnification factors are the basis for the suggested design rules. They are also compared with the magnification factors suggested by the ACI (49-26) Code. It is concluded that the ACI (49-26) Code requires modification and a new design formula is needed, and

(4) the determination of the suggested design formulas. Envelopes are drawn for the different magnification factor curves. Formulas are then derived from these envelopes which are recommended for use in the preliminary design of tall tapered reinforced concrete chimneys on rigid foundations subjected to earthquakes.

105 pages. \$2.00. Mic 57-2069

CERTAIN CHARACTERISTICS OF PARTIALLY FROZEN SOIL

(Publication No. 21,294)

Charles W. Lovell, Jr., Ph.D.
Purdue University, 1957

Major Professor: K. B. Woods

The primary objective of this study was the determination of the relative amounts of frozen and unfrozen moisture in several fine-grained soils over a range of subzero ($^{\circ}\text{C}$) temperature. A secondary goal was the definition of the influence of such partially frozen condition on the strengths of the test soils.

Three soils were utilized – a clayey silt of glacial origin, a silty clay of glacial origin, and a clay weathered in place from limestone. These soils were characterized in the usual engineering manner, followed by special characterization of three types: (a) determination of desorption curves, (b) measurement of the specific heats of the soil solids, and (c) definition of cooling curves.

Combined dynamic and static compaction procedures were developed to allow molding of 1.4 (dia.) x 2.8-inch partially saturated soil samples to good moisture-density uniformity. Such samples were utilized in the two primary test series defining phase composition and strength at subzero temperatures.

A calorimetric method was used to determine the amount of ice in molded specimens of known total moisture, density, and subzero temperature. The variation of unfrozen moisture content (w) with subzero temperature (T) was found to have the equation $w = cT^m$, where c and m are constants. The phase composition of the test soils differed significantly at a given subzero temperature level, and changed appreciably with the lowering of temperature within the range of -1°C to -25°C . For example, comparing soils molded to standard Proctor optimum moisture contents, the following percentages of original moisture frozen obtained: at -3°C , clayey silt 73, silty clay 42, clay 16; at -25°C , clayey silt 83, silty clay 62, clay 51.

Attempts to correlate the results of the experimental desorption tests with the calorimetric data met with very limited quantitative success.

To define the magnitude of partially frozen strengths, unconfined compression tests were undertaken at controlled subzero temperatures, with stress rates of loading of 160 or 200 psi per minute. Compressive strength (∇_{IP}) demonstrated a high subzero temperature (T) dependency for all test soils, which could be expressed in the form $\nabla_{IP} = c \times 10^{mT}$, where c and m are constants. For example, again comparing samples molded to standard Proctor peaks, the approximate ratio of compressive strength at -18°C to that at -5°C was over four to one for the silty clay and almost three to one for the clay.

It was concluded that very substantial proportions of the total moisture (defined by drying to constant weight at 105°C) of fine-grained soils may remain unfrozen at temperatures as cold as -25°C , and that the changes in strength accompanying change in temperature within this range emphasize the practical significance of the relative phase composition of the soil moisture.

187 pages. \$2.45. Mic 57-2070

THE STRESS-DEFORMATION CHARACTERISTICS OF ASPHALTIC MIXTURES UNDER VARIOUS CONDITIONS OF LOADING

(Publication No. 21,326)

Leonard Eugene Wood, Ph.D.
Purdue University, 1956

Major Professor: William H. Goetz

A laboratory study was made of the effects of various conditions of loading upon the stress-deformation characteristics of bituminous mixtures in order to obtain a better understanding of the various basic factors that affect their performance.

The study was divided into four parts. In the first part, using the unconfined compression test on a sand-asphalt mixture, a general relationship between maximum, unconfined compressive strength, temperature, and rate of deformation was developed as follows:

$$x_0 = A^{Bx_1} (Cx_2 + D) \dots \dots \dots (1)$$

where x_0 = maximum, unconfined compressive stress, psi

x_1 = rate of deformation, in./min.

x_2 = temperature, $^{\circ}\text{F}$

A, B, C, D = parameters to be determined from test results.

Multiple linear regression analysis was used to evaluate the above parameters and also to evaluate the degree of association the expression represented.

The validity of this general expression for other mixtures was determined by formulating two different mixtures and evaluating the parameters of the above equation from limited results. With the established parameters, the maximum, unconfined compressive stress was predicted for other test levels. Specimens were then tested for these levels and in most cases there was very close agreement between predicted and observed values.

The validity of the general expression for other loading conditions was determined by performing the compression tests at confining pressures of 15 and 30 psi and making similar comparisons between predicted and observed values.

In the second phase, unconfined, repeated load tests were performed. The concept was brought out that there was a stress that could be cycled a number of times without causing failure (excessive shear deformations) to occur. This stress was labeled the endurance limit. Regardless of the test level, the endurance limit appeared to have a value of approximately 25 percent of the maximum, unconfined compressive stress for that particular test level.

A general relationship between temperature, rate of deformation, number of load repetitions, and applied stress was evolved as follows:

$$x_c = \left[E \cdot 10^{-\alpha(n-1)\beta} + (1-E) \right] x_o \dots \dots \dots (2)$$

where x_c = applied, cycled unconfined compressive stress, psi

x_o = maximum, unconfined compressive stress, psi

n = number of load repetitions necessary to cause excessive shear deformations

E, α, β = parameters to be determined from test results.

Multiple linear regression analysis again was used to evaluate the above parameters. An expression relating the first and second phases of the study was also developed and is presented as follows:

$$\log \log x_c = A + B \log x_1 + Cx_2 + Dx_2 \log x_1 \left[E \cdot 10^{-\alpha(n-1)} + (1-E) \right] \dots \dots \dots (3)$$

where x_c = applied, cycled unconfined compressive stress, psi

x_1 = rate of deformation, in./min.

x_2 = temperature, °F

n = number of load repetitions necessary to cause failure

A, B, C, D, α , and β = constants that are dependent upon mixture composition.

The data suggest that the elastic portion of the deformation takes place principally in the polymolecular film of asphalt which surrounds the aggregate particles.

The third phase consisted of performing confined, repeated load tests. The previous concept of an endurance limit equal to approximately 25 percent of the maximum compressive stress for any given test level was confirmed.

A series of static load tests composed the fourth phase of the study and pointed out quite vividly the difference in mixture characteristics as affected by temperature. At 140°F the mixture was quite plastic in character. At 40°F the mixture appeared to have considerable viscous resistance under static load.

It was concluded that a promising means of evaluating the adequacy of a bituminous mixture before its utilization in the field would be to perform the confined, repeated load test on a rational specimen at a temperature of 140°F and a rate of strain of 0.0005 in./in./min. The degree of confinement to be introduced cannot yet be recommended. From previous work on the strength of bituminous mixtures, it is recognized that some degree of confinement should be used in order to distinguish those mixtures whose strengths are particularly benefited by confinement.

The reasons advanced for these recommendations are as follows: 1) at the given temperature and rate of strain the mixture would be quite plastic in character and the test should indicate the stability of the mixture during summer climatic conditions under repeated slowly moving loads, and 2) the desired property of the mixture would be to have as high an endurance limit as possible.

193 pages. \$2.55. Mic 57-2071

ENGINEERING, ELECTRICAL

REVERSIBLE SUSCEPTIBILITY IN FERROMAGNETS

(Publication No. 21,180)

Dale Mills Grimes, Ph.D.
University of Michigan, 1956

The purpose of this study is to investigate theoretically the variation of the low-frequency reversible susceptibility exhibited by a ferromagnet as a function of the internal magnetization level for small alternating fields both parallel with and normal to a static magnetic biasing field assuming firstly that the susceptibility has its origin in domain-wall motion and secondly that it has its origin in domain rotation. An understanding of this variation is of interest for the insight gained into the methods of magnetization processes as well as for the design of variable-inductance magnetic-core devices. Experimental data are reported and compared with the results of the theory.

To calculate these susceptibilities, a distribution function $f(\Theta)d\Theta$ equal to the fraction of all atomic magnetic moments in the system of interest which makes an angle between Θ and $\Theta + d\Theta$ with respect to the applied biasing field must be known. This involves an effective "history" field which cannot be known. However, such an expression can be developed in terms of a totalized magnetic field equal to the sum of the biasing, demagnetizing and history fields. The inherent assumptions are that the material is polycrystalline and nonoriented, that each atomic magnetic moment is oriented along some "easy" crystallographic direction, that the localized demagnetizing fields act to randomize the particular "easy" direction occupied, and that each cation possesses a magnetostatic energy proportional to the cosine of the angle between its moment and the field direction.

On the basis of the above assumptions, an expression for the magnetization M is derived in terms of the totalized magnetic field H . This is done for magnetization along the [100] and the [111] directions and for isotropy. These correspond respectively to a total of six, eight and an infinite number of easy crystallographic directions.

For the case of parallel fields and magnetization by wall motion, the reversible susceptibility is assumed to be the derivative of the magnetization with respect to the totalized field. For transverse fields and magnetization by wall motion the reversible susceptibility is derived by assuming that the total magnetic field and the moment of the polycrystalline specimen are always aligned.

For the case of magnetization by domain rotation, it is assumed that the Landau-Lifshitz differential equation is applicable to each crystallite. The susceptibility parallel or transverse to the field is calculated by setting the proper component of the alternating field equal to zero.

The unknown totalized field can be eliminated between the susceptibilities and the magnetization since all are functions of $f(\Theta)d\Theta$.

Experimental data, which are reported for three ferrite specimens, are found to lie between the expected theoretical curves for the different magnetization types. The expected curves for the cases of domain-wall movement and domain rotation are sufficiently different to allow an approximate experimental separation of the contribution to the susceptibility from each type.

It is concluded that the theory here presented gives rise to a new technique for the separation of the contribution to the measured susceptibility from each mechanism. Using this technique, it is found that the relative importance of the two mechanisms depends upon the ferrite composition. 139 pages. \$2.00. Mic 57-2072

AN EXPERIMENTAL INVESTIGATION OF NOISE IN TRANSISTORS

(Publication No. 21,244)

Gordon Harold Hanson, Ph.D.
University of Minnesota, 1957

Adviser: A. van der Ziel

The noise generated in a transistor may be represented in an equivalent circuit by a current generator i_p across the collector junction and an emf e_s in series with the emitter junction. This thesis deals with the measurement of these noise generators and their correlation.

The characteristics of i_p have been established by measurements of output equivalent saturated diode current made with the input open. It has been found that the noise is independent of frequency up to approximately $f_\alpha/4$, where f_α is the α cut-off frequency of the transistor. The noise then increases sharply in the neighborhood of f_α . At higher frequencies it is again constant. The ratio of the noise power at the two frequency extremes is approximately $1/(1 - \alpha_o)$ where α_o is the low-frequency current amplification factor. These results hold for transistors whose α cut-off frequencies range from 400 kc to 100 mc. It has been found that the collector saturated current of a transistor shows full shot effect up to frequencies well beyond the α cut-off frequency.

Information on e_s and on the correlation between e_s and i_p has been obtained from measurements of the noise figure. At low frequencies ($f \ll f_\alpha$), e_s and i_p are partially correlated for some transistors, while in others there is little or no correlation.

Except for very small values of the source resistance, by far the greater contribution to the noise figure comes from the current generator i_p . The conditions necessary to achieve minimum noise figure at low frequencies are: (a) selection of a transistor with a current amplification factor α near unity, (b) operation at low collector current, and (c) selection of the optimum source resistance. The value of the optimum source resistance depends strongly on collector current.

At higher frequencies ($f \approx f_\alpha$), noise figure measurements yielded less satisfactory results. The main reason for the difficulties was capacitive feedback between output and input. Another factor of importance at high frequencies is the noise produced in the base resistance of the transistor. This can not always be neglected at frequencies for which the collector resistance is effectively by-passed by the collector capacitance.

The principal experimental results are compared with a theoretical study of transistor noise published recently by van der Ziel.* The measurements of the output current generator i_p are in excellent quantitative agreement with the theory at all frequencies. In addition, the noise

produced by the collector saturated current is the same as that predicted by the theory. The magnitude of the noise generator e_s , as determined from noise figure measurements also agrees with the theoretical values.

According to the theory, there should be no correlation between e_s and i_p except at very small emitter currents. Some correlation was observed, however, in transistors with a low emitter efficiency γ and in drift transistors. In other transistors, the very small correlation found was well within the limits of experimental error.

The general agreement between the experimental results and van der Ziel's theory establishes the validity of the theory in a very convincing manner. Such discrepancies as exist may well be removable by modification of the theory to cover special cases. In particular, the theory assumes that current carriers traverse the base region as a result of diffusion, whereas in drift transistors the motion is due to drift in an electric field.

100 pages. \$2.00. Mic 57-2073

*A. van der Ziel "Theory of Shot Noise in Junction Diodes and Junction Transistors," Proc. I. R. E., 43, pp. 1639-1646, Nov. 1955.

THE UTILIZATION OF MAGNETIC LEVITATION IN STUDIES OF PIEZOELECTRIC QUARTZ CRYSTALS

(Publication No. 21,246)

Andrew O. Jensen, Ph.D.
University of Minnesota, 1957

Adviser: Robert F. Lambert

A new type of piezoelectric quartz crystal mounting based on the principle of magnetic levitation is proposed. A 15 m.m. diameter A. T. cut quartz crystal, of nominal frequency 1 M.C.P.S., is plated on its face areas with iron by the evaporation technique and suspended in vacuum with the aid of a magnetic field whose strength is controlled through a feedback method by the crystal position with respect to a sensitive element. Using an electrostatic type of crystal excitation and evacuating the region about the crystal should eliminate mounting and acoustic radiation losses, thus allowing an absolute determination of the "Q" factor of the quartz crystal resonator. Experiment established the feasibility of such a mounting technique but also revealed that great care must be exercised in the selection and placement of the electrode material on the resonator faces, otherwise mechanical losses in this material seriously degrade the "Q" factor of the composite resonator consisting of the quartz and the electrodes. An absolute determination of the "Q" factor of piezoelectric quartz was not possible in this study.

82 pages. \$2.00. Mic 57-2074

**A NUMERICAL MACHINE TOOL CONTROL
SYSTEM OPERATING FROM CODED
PUNCHED-PAPER TAPE**

(Publication No. 20,943)

Harry Winston Mergler, Ph.D.
Case Institute of Technology, 1956

A machine tool control system meeting stringent requirements of economy and simplicity has been designed, constructed, and successfully operated. The control, designed to effect two-dimensional profiling by a standard milling machine, utilizes punched-tape intelligence, prepared in a binary-coded decimal notation. Controlled profiling at 4 inches per minute to an accuracy of 0.0015 inch has been demonstrated on a variety of geometries. A detailed description of the principles of operation of the system together with complete instructions for data preparation and tape coding is presented. Appendices include circuit diagrams, construction photographs, pertinent design details, performance evaluation on sample geometries, and a method for data preparation on a high-speed digital computer. 156 pages. \$2.05. Mic 57-2075

**AN INVESTIGATION OF IMPULSE VOLTAGE
BREAKDOWN IN POLYETHYLENE**

(Publication No. 21,365)

Charles Rowe Vail, Ph.D.
University of Michigan, 1956

The purpose of this investigation is to determine experimentally some of the characteristics of dielectric breakdown in commercial polyethylene under applied high voltage impulses and to relate these characteristics to physical theory. The study divides naturally into two parts: one concerned with single-impulse breakdowns occurring during the period of rise of overvoltage impulses, and the other concerned with multiple-impulse breakdowns at gradients below the threshold level for single-impulse breakdown.

Physical theories of dielectric breakdown are reviewed and a description given of the instrumentation, the method of preparation of specimens, and the experimental procedures. Results are given for single- and multiple-impulse tests and for measurement of dielectric constant, loss factor, corona inception level, and d-c and 60-cps a-c breakdown gradients. An empirical model of single-impulse breakdown gradient as a function of time to breakdown and specimen thickness is derived statistically.

Single-impulse breakdown is shown to be a function of rise rate and to be characterized by breakdown gradients that exceed the d-c breakdown level for very high rise rates but that may fall well below the d-c level for lesser rise rates. It is speculated that as the rise rate is further diminished below a certain value the value of breakdown gradient will begin an increase that will return it to the d-c level several orders of magnitude later in time.

The following experimental values of breakdown gradient at 85° F are cited: sixty-cycle a-c (crest), 3.4 kv/mil; threshold for single-impulse, 5.8 kv/mil; d-c, 14 kv/mil; steep-front impulse, 20 kv/mil at 0.3 microsecond. The

single-impulse breakdown gradient appears to be independent of thickness in the range from 1.5 mils to 26.5 mils.

It is shown that the prestressing of a specimen with multiple impulses at a reduced voltage immediately before an overvoltage single-impulse breakdown test significantly increases the requisite breakdown gradient and the time to breakdown. The increase of time to breakdown is further shown to consist almost entirely of an increase of formative time lag, with only a slight increase in mean statistical time lag. For non-prestressed specimens, the formative time lag is found to be 0.31 microsecond and the mean statistical time lag, 0.19 microsecond.

The impulse wave is described as undergoing a period of fluctuation immediately preceding breakdown. The duration of this period matches that of the formative time lag, a fact that suggests it to be a symptom of the breakdown process.

The single-impulse breakdown data are shown to fit an extremal distribution curve, a fact that suggests the applicability of weakest-link theory.

Although the multiple-impulse breakdown data are too few for drawing statistically significant conclusions, there is some evidence of an inverse relation between breakdown gradient and number of impulses to breakdown.

It is concluded that the process of impulse breakdown in commercial polyethylene involves a mechanism of electron avalanching that is influenced, for lower rise rates, by partial breakdowns associated with foreign matter, imperfections, and voids, while for higher rise rates, it is strongly influenced by "electrode conditioning" due to emission from the cathode. Prestressing is thought to increase the breakdown voltage through the electrode conditioning process and through a process of repairing defects in the material.

Further investigation is suggested on the points of the prebreakdown voltage fluctuation and of the multiple-impulse breakdown characteristic.

157 pages. \$2.10. Mic 57-2076

ENGINEERING, MECHANICAL

**EXPERIMENTAL INVESTIGATION OF THE
EFFECT OF SURFACE ROUGHNESS ON
SHOCK-WAVE ATTENUATION**

(Publication No. 21,108)

Rai Bisheshwer Nath Bhargava, Ph.D.
Columbia University, 1957

A shock-wave traversing a tube filled with a gaseous medium attenuates because of various dissipative forces. In this study the effect of surface roughness on shock attenuation was investigated by measuring the shock attenuation in three different tubes of the same length and diameter (12 ft. long, 0.493 in. inside diameter) but of different surface roughnesses. The coefficient of friction for each pipe was measured under steady-flow conditions and equivalent sand-roughness sizes, as defined by Nikuradse, were computed.

A diaphragm, separating the high-pressure section of the

shock-tube from the low-pressure section, was shattered to create a shock-wave. It was found that the shock-wave thus created does not attain the intensity predicted by the inviscid flow theory. To determine the attenuation of the shock-wave the intensity of the same shock-wave was measured at two positions; one before and another after the shock-wave had traversed a known length of the tube. An initial length of travel preceded the first position so that the discrepancies introduced by the diaphragm rupture and by the shock-wave-formation losses are eliminated.

Two transducers depending on resistance-wire strain gauges were built which were used in conjunction with two strain gauge bridge amplifiers. These transducers were calibrated under static load conditions and it was shown experimentally that this calibration was valid for dynamic transient measurements.

To obtain two pressure measurements of the same shock-wave at two positions a triggering-pulse generator and a bistable electronic switch were designed and built. The triggering-pulse generator produced three pulses when an electric circuit passing through the diaphragm, separating the high- and low-pressure sections of the shock-tube, was broken by shattering the diaphragm. Two of these pulses, one of which originated at the moment the diaphragm was shattered and the other after a predetermined interval, were used to trigger the oscilloscope sweep. The third pulse, produced at the same instant as the second of the above mentioned pulses, was used to actuate the switching operation of the electronic switch. Thus, though the outputs of both transducers were fed into the electronic switch, only one signal at a time was transmitted to the oscilloscope. A camera was attached to the oscilloscope to photograph the two traces obtained on the oscilloscope screen. These two tracings show the pressure-time history at the two positions of pressure measurements.

It was found that the surface roughness has a pronounced effect on shock-wave attenuation which is higher for increasing roughnesses. The experimental values of shock attenuation in a smooth pipe were compared with existing theories. It was found that the theory based on complete turbulent-boundary-layer shows higher attenuation than that observed while the laminar-boundary-layer theory predicts lower attenuation than that observed. The plot of the measured data faces close to the curve predicted by the laminar-boundary-layer theory rather than that for the turbulent-boundary-layer even though the flow Reynolds number, based on length, attains the value 3.2×10^5 within a travel of few diameters, indicating a very short length of laminar-boundary-layer. The information obtained, however, was not considered sufficient to formulate a comprehensive analytical solution.

144 pages. \$2.00. Mic 57-2077

USE OF THE CONSTANT-VOLUME BOMB TECHNIQUE FOR MEASURING BURNING VELOCITIES

(Publication No. 21,279)

Richard Corey Eschenbach, Ph.D.
Purdue University, 1957

Major Professor: John T. Agnew

Measurements have been made of the flame speed of three stoichiometric mixtures in a constant-volume bomb at initial pressures ranging from 0.1 to 20 atmospheres. The flame speed was measured using an ionization gap technique which permits a bomb construction suitable for use at much higher initial pressures than have been used heretofore.

The equations needed for obtaining burning velocity, S_u , from the observed flame speed, S_s , are developed from first principles.

The analysis of errors shows that in general it is more difficult to get reliable values of burning velocity from pressure measurements alone, than from radius measurements alone. It is shown that when only pressure or only radius measurements are obtained, chemical equilibrium in the burned gas must be assumed in order to calculate a burning velocity. Analysis of effects due to the finite rate of pressure propagation shows that neglect of this factor can cause serious errors in burning velocities determined from pressure measurements. It is also shown that it is difficult to obtain much accuracy in a direct measurement of the expansion ratio with simultaneous radius and pressure measurements.

Measurements of flame speed were made with stoichiometric methane-oxygen at pressures from 0.1 to 2.0 atmospheres. Burning velocities computed from these measurements can be fitted by the equation:

$$S_u = 381 p^{.085} \quad (S_u \text{ in cm/sec, } P \text{ in atm})$$

The flame speeds of stoichiometric methane-air at pressure of 1 and 19.6 atm. were measured. The burning velocity obtained at 1 atm. was 32.7 cm/sec. The computed burning velocity at 19.6 atm., 13.8 cm/sec, is thought to be slightly below the true value.

The flame speed of stoichiometric ethylene-air was measured at 1 atm. The burning velocity computed was 730 cm/sec.

In the course of the experiments it was established that the effect of the ionization electrodes on the observed flame speed was less than random measurement errors. It was also found that at conditions corresponding to a ratio of flame radius to quenching distance of less than five, the flame speed was less than at larger radii. This effect was tentatively ascribed to lack of chemical equilibrium in the burned gas.

With the methane-oxygen and ethylene-oxygen mixtures, an acceleration of the flame front was observed at about the time a pressure wave starting from the origin and reflected at the bomb wall would intersect the flame front.

111 pages. \$2.00. Mic 57-2078

A STUDY OF THE CHARACTERISTICS OF DASHPOTS: SOME DESIGN CRITERIA FOR HYDRAULIC SHOCK ABSORBERS

(Publication No. 21,441)

Ching-u Ip, Ph.D.
The Ohio State University, 1956

The study presents a rational approach for the designing of the air column and the orifice of an oleopneumatic shock absorber. The method answers, for instance, the question: What size of orifice and what length of air column should the designer prescribe (a) if no force of more than F lb. should be transmitted to the body to be stopped, or (b) if the body should settle down to a specified displacement from the static-equilibrium position t seconds after the instant of impact?

The equation of motion of a shock-absorbing system of one degree of freedom can be expressed as:

$$\frac{W}{g} \ddot{y} + K_d \left(\frac{\dot{y}}{a} \right)^S + p_a A \left[(1 - y/\ell)^{-n} - 1 \right] = W$$

where

- W = weight of the body (lb.)
- y = displacement of the body measured from the no load position (in.)
- A = cross-sectional area of piston (sq. in.)
- a = cross-sectional area of orifice (sq. in.)
- K_d = damping constant
- S = damping index
- p_a = atmospheric pressure (p.s.i.)
- ℓ = length of air column (in.)
- n = polytropic gas constant

The constants K_d , S , and n for any particular shock absorber can be experimentally determined, and the methods of determination are described in §6.

In the case of a preliminary design where no existing shock absorber is available, the orifice damping term in the equation is approximated by

$$\frac{\rho A^3}{2} \left(\frac{\dot{y}}{a} \right)^2$$

where ρ = mass density of the fluid (lb.-sec.²/in.⁴) and hydraulic damping is assumed ($S = 2$).

The nonlinear differential equation of motion is then solved by the numerical integration method of Bickley (§9) and by the aid of an analogue computer (§11 and 12). The maximum retardation of the body is found to occur at the instant of impact. It follows that the design of the orifice for a maximum permissible force of F lb. can be accurately and approximately obtained from the following equations, respectively:

$$K_d \left(\frac{\dot{y}}{a} \right)^S = F$$

$$\rho \frac{A^3}{2} \left(\frac{\dot{y}}{a} \right)^2 = F$$

The design of the shock absorber for a specified "settle-down" time has to be accomplished by obtaining the displacement-time relationship of a large number of shock absorbers having various sizes of orifice and various lengths of air column. This is most easily done with the aid of the analogue computer. A specific example is presented in 12.

Design methods of other investigators on allied problems are presented in the appendixes.

89 pages. \$2.00. Mic 57-2079

THE EVAPORATION OF SINGLE LIQUID DROPS, INCLUDING THE EFFECTS OF ULTRASONIC ENERGY ON EVAPORATION

(Publication No. 21,339)

William Mirsky, Ph.D.
University of Michigan, 1956

The study is concerned with the evaporation of single-drops of liquids and the effects of relative air velocity and ultrasonic energy on the evaporation process. Interest in such studies is based on the need for additional fundamental information relating to the combustion process of liquid fuel drops in a spray.

The investigation is both theoretical and experimental, the theoretical portion being concerned mainly with the evaporation of drops suspended on filaments in constant velocity air streams. The experimental parts deal with evaporating drops suspended on filaments in constant velocity air streams, both with and without the influence of ultrasonic energy, and with freely suspended evaporating drops at their terminal velocity and influenced by ultrasonic energy.

A new technique for maintaining freely-suspended drops at a fixed position in space by means of air drag and ultrasonic forces is described. For slowly evaporating drops the apparatus is capable of limiting drop motion to 1 mm or less in all directions.

The theoretical study is based on the heat-transfer process occurring through an assumed spherical thermal boundary layer. The resulting evaporation equation shows that the rate of evaporation is dependent upon the ratio D/D_f where D is the drop diameter and D_f is the diameter of the assumed thermal boundary layer. When D/D_f is assumed constant, the equation reduces to

$$D^2 = D_0^2 - \lambda t$$

as found by others. D_0 is the initial drop diameter, λ the evaporation constant, and t the elapsed time of evaporation. However, when the expression for D/D_f is obtained from boundary layer considerations, it is found to be a function of $(Pr)^{1/3}$, $(Re)^{1/2}$ and a semiempirical factor f . The resulting equation is applied to drops evaporating in a constant velocity air stream, giving

$$(D_0^{3/2} - D^{3/2}) - \frac{3}{2} C (D_0 - D) + 3C^2 (D_0^{1/2} - D^{1/2}) - 3C^3 \ln \left(\frac{D_0^{1/2} + C}{D^{1/2} + C} \right) = \frac{6K}{C\rho c} \ln \left[1 + \frac{c(T_f - T)}{L} \right] t,$$

where C is dependent upon f , Prandtl number, relative velocity, and the mean kinematic viscosity of the boundary film; k is the mean thermal conductivity of the boundary film; ρ is the density of the liquid drop; c is the specific heat of the drop vapor; T_f = ambient temperature; T = drop temperature; and L is the latent heat of the drop. This equation shows close agreement with experimental results.

Cumene was used for all fixed-drop experiments because of its suitable evaporation rate. Drops, suspended

on a glass filament approximately 60 microns in diameter, were evaporated in constant air streams of from zero to 8.6 feet per second. Drop size range extended from about 1300 to 300 microns. Experimental results are correlated by

$$D^n = D_0^n - \lambda t,$$

where n was found to be dependent upon relative air velocity and approaches the value two for evaporation in stagnant air. At the higher velocities n is approximately 1.5.

The presence of ultrasonic energy is shown to have a pronounced effect on the evaporation process. In general, the evaporation rate increases with an increase in ultrasonic intensity and decreases as the ultrasonic frequency is shifted from its critical value for the system. For the apparatus used, the critical frequency varied with relative air velocity.

When drops of pure liquid are freely suspended in the standing-wave ultrasonic field the evaporation is such that drop diameter becomes a linear function of elapsed time of evaporation.

All drop measurements were obtained from silhouette photographs made with a 16-mm motion picture camera.
158 pages. \$2.10. Mic 57-2080

EVAPORATION AND COMBUSTION OF SINGLE FUEL DROPLETS IN A HOT ATMOSPHERE

(Publication No. 21,355)

Michel Aziz Saad, Ph.D.
University of Michigan, 1956

This dissertation deals with a study of the combustion of falling fuel droplets in a hot atmosphere. The investigation was undertaken as a first step toward the understanding of the more general problem of combustion of a fuel spray.

The experimental procedure consisted in allowing single fuel droplets to fall freely in a vertical furnace. After leaving a fuel dropper, the droplets accelerated to about 87% of their terminal velocity by the time the first photographing stage was reached. Each droplet was photographed at several positions as it fell, and a record of droplet diameter and elapsed time was obtained. At every photographing stage, the droplet was detected by a multiplier phototube which actuated a high-speed photolight. The time intervals between successive photographs were determined by super-imposing timing pips upon the traces obtained from a 60-cycle square-wave generator on an oscilloscope.

The fuel droplets fell in the furnace under gravity, buoyancy, and drag forces. They were burned in hot air while exposed to thermal radiation from the furnace walls. Reynolds number was not a controllable factor because the droplets changed in both diameters and velocities during their fall.

Kerosene and two pure hydrocarbon fuels, n -heptane and isooctane, were investigated at a furnace temperature of 1500°F. The range of droplet diameter was approximately 1150 μ to 300 μ .

The combustion of the fuels investigated depended on

the properties of the fuel, droplet size, and the relative velocity between the droplet and the furnace atmosphere, other factors such as ambient temperature and furnace atmosphere being unchanged.

Preheating of the droplet was mainly by conduction and convection from the ambient atmosphere, since radiation from the furnace walls was found to have a comparatively small effect. The heat transfer to the interior of the droplet modified the rate of vaporization since an appreciable portion of the heat transferred was used for the internal heating of the droplet. During combustion, heat was transferred to the droplet from the local flame produced by the combustion of the vaporized fuel around and in the wake of the droplet.

The change of droplet size of the fuels investigated was represented by the equation

$$D^2 = D_0^2 - C\Theta,$$

where D is the diameter of the droplet at time Θ , D_0 is the initial diameter of the droplet, and C is the coefficient of combustion. C was found to depend on the nature of the fuel and the velocity of the falling droplet. For the fuels investigated C varied from 0.02 to 0.025 cm²/sec.

The experimental results show that the presence of the flame decreased the drag of the falling droplet.

137 pages. \$2.00. Mic 57-2081

A STUDY OF CERTAIN ASPECTS OF A TWO-STROKE CYCLE, SPARK-IGNITION ENGINE WITH GASOLINE INJECTION

(Publication No. 21,313)

Benjamin Long Sheaffer, Ph.D.
Purdue University, 1957

Major Professor: O. C. Cromer

The object of this investigation was to study certain phenomena affecting the performance of a two-stroke cycle, spark-ignition engine with gasoline injection. The engine used for this research was a General Motors Corporation, uniflow-scavenged (with poppet exhaust valves), single cylinder, 71 series diesel engine which was converted to gasoline injection and spark ignition. The injection system was composed of a Bosch injection pump which was driven off the engine crankshaft and a nozzle which was located in the cylinder head. A few tests were also made with injection into the air box and injection into the cylinder through one of the inlet ports. Two different cylinder liners were used for the investigation, one with the inlet ports radially inclined and the other with the ports inclined at an angle of 25° from the radial direction. A steel spacer installed between the cylinder head and the cylinder block lowered the engine compression ratio from 16/1 to 7/1.

The effects of the injection variables upon the power output were assessed over the entire speed range of the engine. It was found that the most important factors in securing complete mixing of the gasoline and air were the spray distribution of the nozzle and the injection duration. A rotary flow of air around the cylinder axis aided the mixing process greatly. The power output of the engine was not greatly affected by rather large variations in the

injection timing; the optimum injection beginning was in the vicinity of bottom dead center. It was found that if the proper combination of spray distribution, injection duration, and air swirl was used the nozzle-opening pressure could be reduced to 500 psi. Lower nozzle-opening pressures caused poor spray qualities.

Scavenging tests were conducted on the engine by means of the method described by Taylor.* The oxidized exhaust gas method was used to determine the air-fuel ratio from a sample of the blowdown gas. Below the stoichiometric air-fuel ratio the scavenging efficiency was found to be constant; however, at higher air-fuel ratios the scavenging efficiency apparently increased. The reason for this increase could not be ascertained.

It was found that for the two inlet port angles tested there was no significant difference at the 1% level in scavenging efficiency. For a constant value of scavenging ratio, the scavenging efficiency was found to decrease when the speed was increased from 1100 to 1500 rpm.

A concept of the scavenging process in uniflow-scavenged engines was presented along with suggestions as to how the scavenging might be improved.

Photographs of the pressure traces and the combustion process under typical operating conditions were presented.

Attempts to secure charge stratification by retarding the start of injection were unsuccessful.

Two ideas for obtaining charge stratification by utilization of an auxiliary combustion chamber were presented.

Recommendations were made concerning future research on the two-stroke cycle, spark-ignition engine.

Forty-two cited references and ninety-four additional references were given. 113 pages. \$2.00. Mic 57-2082

*Taylor, C. F., and Rogowski, A. R., "Scavenging the 2-Stroke Engine," *S. A. E. Trans.*, Vol. 62, 1954, pp. 486-502.

THE INFLUENCE OF FINITE BLEED VELOCITIES ON THE EFFECTIVENESS OF BASE BLEED IN THE TWO-DIMENSIONAL SUPERSONIC BASE PRESSURE PROBLEM

(Publication No. 20,898)

Chen-Yuan Wu, Ph.D.
University of Illinois, 1957

The present investigation is concerned with the study of the influence of finite subsonic bleed velocities on the effectiveness of base bleed in the two-dimensional supersonic base pressure problem. Two predominant parameters in the base bleed problem, the bleed mass rate per unit area of the base and the velocity of the bleed stream entering the base, are established and analyzed.

A two-dimensional back step base bleed flow model was employed which exhibits the principle of interaction between the dissipative flow in an initially disturbed turbulent mixing region and the adjacent free stream, as was previously suggested and used in the treatment of other aspects of the base pressure problem. The base bleed model may also be interpreted as representative for dealing with the effects of boundary layer build-up upstream of the separation corner of the base.

The results of the theoretical and experimental

investigation indicate that at a given approach Mach number of the main stream and a given bleed mass flow rate, a higher bleed velocity gives a lower base pressure ratio so that the "zero velocity" base bleed imposes an upper limit to the effectiveness of base bleed. Also, the theoretical "zero velocity" base bleed solution gives good predictions for the actual base pressure with mass bleeding at small bleed velocities. For the base bleed technique to be effective, the area of the bleed jet exhausting into the base should be as large as possible. Experimental information obtained with the free stream approaching the base at Mach numbers between 1.79 and 1.95 gave strong support to the general concept concerning the jet mixing component of the base flow model employed in the present investigation and suggested that the base pressure with mass bleeding at finite bleed velocities be predicted for other cases than those experimentally treated in the present research. 73 pages. \$2.00. Mic 57-2083

ENGINEERING MECHANICS

A NUMERICAL SOLUTION TO THE DEFORMATION OF A TENSION STRIP CONTAINING A HOLE

(Publication No. 20,880)

David Henry Offner, Ph.D.
University of Illinois, 1957

The purpose of this study was to solve numerically the following problem: Determine the elastic deformation of a tension strip having a width, b , a length, $3/2 b$, and a symmetrically placed circular hole of diameter, $b/2$. The deformations are to be in terms of the longitudinal (U) and transverse (V) displacements of a discrete number of points in the strip. The U - and V - displacements along the two ends are assumed to be constant and zero respectively. Normal and shearing stresses at all other boundaries are assumed to be zero.

Interest in solving this problem came from two principal observations. Firstly, accurate determination of elastic deflections in machine members and structural parts has become increasingly necessary with the use of high strength alloys which permit high stresses accompanied by relatively large deflections. Methods for obtaining deflections based on such approximations as nominal stress distribution are not valid for the magnitude of deflections to be expected in many problems. Thus recourse to numerical methods usually becomes necessary. Secondly, in problems where a direct solution of stresses by numerical means is impractical because of the condition of the governing finite difference equation, numerical solutions of the deflections provide a basis from which to obtain the stresses.

Due to the symmetry of the tension strip, displacements in only one quadrant were required. The general procedure used to solve the problem and verify the solution was as follows:

1. Boundary conditions were defined in terms of displacements requiring two partial differential equations of

equilibrium to be satisfied, which were also expressed in terms of displacements.

2. These governing equations were replaced by central finite difference equations using three points for approximating second partial derivatives. The finite difference equations were modified for points on the boundary to satisfy the boundary conditions. This also enabled the points required in the finite difference scheme which were located external to the boundary to be eliminated in terms of interior and boundary points.

3. Points on the curved boundary required special consideration. The boundary conditions were approximated in terms of forward difference equations and the boundary slightly distorted to maintain a standard grid spacing.

4. The resulting set of simultaneous equations was solved by means of the automatic computer available at the University of Illinois using the Gauss Reduction method. The maximum number of equations used in this study was 130. Special programming procedure was developed to facilitate the preparation and checking of a large number of equations for machine computation. A description of this procedure is included in the thesis.

For checking purposes in the preliminary phase of this study and for later comparisons, values of the displacements in a solid plate of the same proportions as the tension strip were obtained. Also the known displacements near the hole for an extended infinite plate were computed and plotted.

To provide a basis for appraising the approximations and resulting solutions of the numerical procedure, a specimen was machined from Aluminum 7075T-6 to the same proportions as the tension strip. The end conditions were approximated by "joining" the ends with a relatively large volume of material. Thus the thick section could be considered "rigid" and constant displacements assumed at the juncture. U- and V- displacements at significant points in the specimen were obtained using ordinary strain gages and a Universal type testing machine.

The main conclusions from this study were as follows:

1. Good agreement between the numerical and experimental results indicated that the central finite difference approximations, curved boundary simplifications, and grid size used in this problem were satisfactory for determining displacements.

2. The governing partial difference equations were favorably convergent and stable. These conditions suggest obtaining stresses from displacements in problems where a direct solution to stresses is not possible or practical.

3. The determination of displacements near irregular boundaries provide basic information about "strain concentration" in problems where deflections are of primary concern.

4. Two equations must be satisfied at every point when the governing finite difference equations of equilibrium are in terms of displacements. This requirement decreases the number of points that can be used with a high speed computer of a given capacity.

5. By means of a careful programming procedure, the preparation and checking of a large number of simultaneous equations (130) for solution by an automatic computer can be accomplished with little difficulty.

92 pages. \$2.00. Mic 57-2084

AXIALLY SYMMETRIC DEFORMATION OF A SHALLOW CONICAL SHELL

(Publication No. 20,893)

Gerald Arthur Wempner, Ph.D.
University of Illinois, 1957

The analysis is concerned with finite deformations of a shallow conical shell of uniform thickness. It is applicable to a thin truncated shell subjected to axial forces uniformly distributed along the edges of the shell. The material is considered to be isotropic and linearly elastic.

The use of shallow conical shells as spring elements has been discussed in numerous papers. In the design of these springs most calculations have been based on relations obtained by Almen and Laszlo (1) for a shell with free edges. Their analysis was found on the assumption that normals to the middle surface remain straight, normal and inextensional. Furthermore, they assumed that the shell remains conical after deformation and that the meridional strain is negligible.

The basic assumption that normals to the middle surface remain straight, normal and inextensional is retained in the present analysis. The deformation is described in terms of the radial displacement and the rotation of a meridian of the middle surface. By means of strain relations given by E. Reissner (2) the potential energy integral is written in terms of these displacement components. Solutions of the problem are obtained by the application of the principle of stationary potential energy. Two methods of solving the problem are presented. These methods are applied to shells with two types of edge support; namely, 1) both edges free, 2) the outer edge free and the inner edge simply supported.

Although the meridional strain is not neglected by the first method, it is assumed that the shell retains its conical form. This assumption simplifies the potential energy integral so that rigorous analysis can be employed to obtain the solution. By the application of variational procedures a general solution is obtained. Since this solution requires a simplifying assumption it is referred to as the approximate solution.

Without the assumption that the deformed shell is conical, the application of variational procedures to the potential energy integral yields two non-linear differential equations (Euler equations). These equations and the boundary conditions are reduced to an integral equation in a single variable, the rotation of a meridian of the middle surface. The second method of solution is the numerical solution of this integral equation. Numerical procedures are employed in conjunction with a method of successive approximations. The practical application of the numerical procedure is made possible through the use of a high-speed digital computer.

From a practical point of view the most important results are the formulas given by the approximate solution, since these are easily applied to shells with either of the two types of edge support. For free edges the approximate solution is a refinement of that obtained by Almen and Laszlo (1). Comparisons show the approximate formulas to be in good agreement with the numerical solutions.

The numerical procedure used to solve the integral equation of the more exact analysis can also be applied to other similar problems.

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2. Reissner, E., "On the Theory of Thin Elastic Shells," Reissner Anniversary Volume, pp. 231-247, J. W. Edwards, Ann Arbor, Michigan, 1949.

84 pages. \$2.00. Mic 57-2085

ENGINEERING, METALLURGY

PLASTIC FATIGUE

(Publication No. 20,937)

Fred John Anders, Jr., Ph.D.
Case Institute of Technology, 1956

The plastic fatigue properties of several steels in a notched condition were investigated. A direct stress fatigue machine which subjected the test pieces to strain cycles of nearly invariant amplitude during any given test was employed to study the effect of material and testing variables upon plastic fatigue life.

The plastic fatigue resistance was proportional to the tensile strength up to strength levels of about 180,000 psi. Above this limit the toughness of the steel, as measured by the V-notch impact test, appeared to be a significant factor in determining the behavior.

Two steels whose strength level was below 180,000 psi exhibited different notch sensitivities in the plastic fatigue test. Precracked specimens were employed to demonstrate that these materials also possessed different crack propagation resistances. Tests at various temperatures with specimens of different initial geometries indicated that the deficiency in fatigue resistance for one of the materials at a low temperature was probably attributable to a decrease in crack propagation resistance. All of these effects may be rationalized on the basis that the crack propagation portion of fatigue life was correlated with toughness, as measured by the V-notch impact test.

80 pages. \$2.00. Mic 57-2086

THE SOLUBILITY OF NITROGEN
AND OXYGEN IN SOLID CHROMIUM

(Publication No. 21,400)

Donald Caplan, Ph.D.
Rensselaer Polytechnic Institute, 1956

Supervisor: Arthur A. Burr

Using specially purified metal, the solubility of nitrogen and oxygen in chromium is determined. The former was studied over the temperature range 500 to 1320°C and the latter over the range 850 to 1510°C. From these data the enthalpy of solution of the gas in the metal and the enthalpy of solution of the first compound to form is calculated for

both the chromium-nitrogen and chromium-oxygen systems.

A capsule technique is developed for determining the solubility of gases in metals. It involves encapsulating the purified metal in mixed powders of the metal and the phase in equilibrium with the terminal solution, heating at various test temperatures, and analyzing the specimens for their gas content. By using specimens of two different thicknesses in one capsule, the same technique permits the determination of the diffusion coefficient of the gas in the metal.

To provide specimen material sufficiently low in nitrogen and oxygen it is found necessary to treat the chromium sheet in purified hydrogen at high temperature in a metal muffle; use of ceramic reaction vessels results in contamination of the specimens. The presence of small amounts of more reactive metals is shown to lead to erroneously high apparent solubilities.

From incidental observations made in the course of the investigation, it is possible to draw qualitative conclusions regarding the effect of nitrogen and oxygen on the ductility of chromium: recrystallized chromium sheet is found to exhibit some ductility at room temperature with nitrogen or oxygen contents as high as 0.04%.

69 pages. \$2.00. Mic 57-2087

A STUDY OF THE FUNDAMENTALS OF THE
EFFECT OF DEOXIDATION ON THE CREEP
CHARACTERISTICS OF PLAIN CARBON STEEL

(Publication No. 21,172)

Clayton Dale Dickinson, Ph.D.
University of Michigan, 1956

The relationship between the creep strength and dissolved nitrogen in plain carbon steels was studied in order to explain the wide variation in the reported creep strength for plain carbon steels with different deoxidation practices and heat treatments.

This relationship between nitrogen and creep rate was studied for a group of commercial plain carbon steels which were representative of the range of rimmed, silicon and aluminum deoxidation practices for plain carbon steel. A specially prepared group of vacuum melted and air melted steels was also tested.

The creep rates of the steels were determined for the 500 to 600 hour interim at 850° F. and 15,000 psi. The dissolved nitrogen was determined by the difference between the values for the total nitrogen and the nitrogen in the form of nitrides in the steel. The amount of dissolved nitrogen in the steels was changed by varying the heat treatment or processing prior to the creep tests.

For the heat treated deoxidized steel, the logarithm of the creep rate showed a very significant linear decrease with an increase in the amount of nitrogen in solid solution. The deoxidation practice and heat treatment had no real effect on the creep rate except for the effect of these processes on the nitrogen in solid solution in the steel.

The logarithm of the creep rate of rimmed steels was found to decrease linearly with an increase in total nitrogen; however, the rate of increase in strength from nitrogen is not as great for rimmed steels as for deoxidized steels.

Hot rolling, stress relieving and spheroidizing processes were found to cause a change in the amount of nitrogen in solid solution in the steel. The creep rate of both silicon and aluminum killed steels was related directly to the amount of nitrogen retained in solid solution after these treatments.

Removal of nitrogen by vacuum melting or vacuum annealing caused the creep rate to increase to the same degree as the removal of nitrogen by the precipitation of nitrides.

No consistent relation was found which related creep rate with austenitic grain size, microstructure or hardness. The level of creep rate increased with manganese in the range of 0.00 to 0.82 percent for a narrow range of low dissolved nitrogen. However, increased dissolved nitrogen further decreased the creep rate at all manganese levels.

The relation between creep rate and dissolved nitrogen consistently explained the effect of deoxidation and prior processing on the creep strength. Silicon deoxidized steels have high creep strength in most conditions of heat-treatment because the nitrogen is dissolved and retained in solid solution by these treatments. The nitrogen in fully deoxidized aluminum killed steels is precipitated as aluminum nitride for most heat treatments. Heat treatments which improve the creep strength of aluminum killed steels also increase the dissolved nitrogen. Rimmed steels are strengthened by nitrogen, but the absence of silicon or aluminum in the steel to interfere with the movement of the nitrogen atoms, reduces the strengthening effect of nitrogen in rimmed steels at temperatures above about 600° F.

Nitrogen increased the strength of steel only under conditions which involve plastic deformation. A modification of Cottrell's strain aging mechanism offers the best explanation for this behavior.

142 pages. \$2.00. Mic 57-2088

THE EFFECT OF CATHODIC AND PRESSURE-DIFFUSED HYDROGEN ON THE HARDENABILITY OF SOME PLAIN CARBON STEELS

(Publication No. 21,060)

Douglas Jack Harvey, Ph.D.
Michigan State University, 1955

In this work steels are hydrogenized using two methods: cathode charging, and heat-treating from a hydrogen atmosphere. The hardenabilities of specimens cathodically charged before heat-treating are compared to the hardenabilities of uncharged specimens. It is concluded that the amount of hydrogen obtained from cathode charging (estimated to be 5 to 7 milliliters per 100 grams) does not measurably affect the depth of hardening. Specimens are austenitized in hydrogen at 15 atmospheres, and quenched. These pressure-hydrogenated specimens show a greater depth of hardening than identical specimens heated in 1 atmosphere of nitrogen. Hardenability is measured by the method of symmetrical U-curves. In this work three steels are used ranging in carbon content from 0.33 percent to 0.50 percent. Some conclusions drawn are: (1) Hydrogen in amounts on the order of 15 milliliters per 100 grams

has a small but definite effect on the hardenability of steel. (2) The increase in hardenability brought about by hydrogen content is negligible in commercial heat-treating practice, as the hydrogen content of steel is ordinarily very low. (3) The hardenability increase brought about by hydrogen appears not to change with carbon content (as in the case of boron). Also, some observations concerning hydrogen-produced cracks are discussed.

98 pages. \$2.00. Mic 57-2089

CORROSION OF COPPER IN SULFURIC ACID

(Publication No. 18,710)

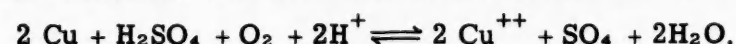
Neldon Lamont Jensen, Ph.D.
University of Utah, 1956

Chairman: Dr. Milton E. Wadsworth

The corrosion of copper in sulfuric acid solutions was investigated, and the rate of corrosion was measured by determining the amount of cupric ion in the solution at various periods of time, and under known conditions. The rate was determined as a function of time, agitation of the solution, acid concentration, and partial pressure of oxygen. A mechanism was postulated that satisfied the experimental observations.

The corrosion of copper was found to be linear over the range of time under all the conditions investigated, and the rate was observed to be directly proportional to the partial pressure of oxygen. The rate, as a function of sulfuric acid, indicated an adsorption process in which the active adsorbate was undissociated sulfuric acid.

Calculations of the energy of activation for the over-all process using the Arrhenius equation was found to be 14.2 kcal per mole. The rate-determining portion of the process was considered to be the adsorption of undissociated sulfuric acid, followed by a rearrangement on the surface. The adsorbed species reacted with molecular oxygen and decomposed through an activated complex into the products of the reaction. The net reaction was considered to be



The data were correlated by applying the Eyring theory of absolute reaction rates.

61 pages. \$2.00. Mic 57-2090

THE OXIDES AND OXIDATION OF MOLYBDENUM-NICKEL ALLOYS

(Publication No. 21,443)

William Lawrence Larsen, Ph.D.
The Ohio State University, 1956

X-ray diffraction, weight change upon oxidation, and metallographic examination have been employed to study the mechanism of oxidation at 950°C. of molybdenum-nickel alloys in the compositional range from 50 to 100 atomic per cent molybdenum.

It was found that these alloys form two principal oxide

layers, MoO_2 lying adjacent to the metal and NiMoO_4 lying on the surface. The outward diffusion of molybdenum was found to be small, MoO_2 being formed at the metal-scale interface by the inward diffusion of oxygen. The outward diffusion of nickel was found to be relatively large. At the MoO_2 - NiMoO_4 interface, new NiMoO_4 is formed by the reaction $\text{Ni} + \text{MoO}_2 + 2\text{O} = \text{NiMoO}_4$.

Resistance to oxidation depends upon the existence of both scales. The inner scale, MoO_2 , provides the greater resistance to diffusion of oxygen, molybdenum, and nickel, while the outer scale, NiMoO_4 , is necessary to prevent the loss of MoO_2 by oxidation to MoO_3 .

Lack of oxidation resistance can be explained by mechanical failure of the NiMoO_4 scale or its occurrence with a volume ratio of less than one.

The compounds NiMoO_4 and CoMoO_4 were found to be isomorphous in each of two polymorphs. They were found to have a crystal structure different from any molybdates hitherto reported. The high temperature (β) form of NiMoO_4 was found to be monoclinic with the cell parameters:

$$\begin{aligned} a_0 &= 9.696 \text{ \AA} \\ b_0 &= 9.163 \text{ \AA} \\ c_0 &= 6.693 \text{ \AA} \\ \beta &= 107^\circ 01' \end{aligned}$$

The probable space group is $C_{2/m}$ with the unit cell containing 8 molecules. The indexed powder diffraction pattern for β NiMoO_4 is given. The structure of the low-temperature form, α NiMoO_4 , was not determined, but the powder diffraction pattern is given.

The phase transformation $\beta \rightarrow \alpha$ was studied and found to be the cause of the violent rupturing of the NiMoO_4 scale upon cooling.

The results of this research have been applied to a general discussion of catastrophic oxidation. It has been concluded that catastrophic oxidation will take place when molybdenum can exist combined as a liquid oxide. The severity of catastrophic oxidation is directly proportional to the amount of molybdenum uncombined in solid oxides. Semi-quantitative agreement is found between predictions and the results of other investigators.

Certain "anomalous" results observed in the oxidation of molybdenum and molybdenum-nickel alloys are cited. These point to the possible existence of a method of oxidation protection different in principle from that generally observed in the molybdenum-nickel system. A suggested explanation is offered. 179 pages. \$2.25. Mic 57-2091

THE EFFECT OF LADLE ADDITIONS OF ALUMINUM, CALCIUM, SILICON, AND GRAPHITE ON THE EUTECTIC SOLIDIFICATION, MICROSTRUCTURE, AND PHYSICAL PROPERTIES OF HYPOEUTECTIC GRAY CAST IRONS

(Publication No. 21,069)

Denton Delbert McGrady, Ph.D.
Michigan State University, 1956

Major Professor: Howard L. Womochel

A study was made of the relative effectiveness of pure aluminum, calcium, silicon, and graphite as inoculants for gray cast irons of a nominal composition of 2.85% carbon, 2.25% silicon, 0.90% manganese, 0.17% phosphorus, and 0.07% sulfur. Cast irons melted in an indirect-arc rocking furnace were inoculated with aluminum and calcium and compared to untreated irons of identical analysis. Comparative data are included on graphite distribution, chemical analysis, cell size, chill depth, transverse strength, deflection, and triangular resilience.

Cast iron melted in a high frequency induction furnace were poured into dry sand molds and time-temperature solidification curves automatically recorded for untreated iron and for irons inoculated with 0.6% aluminum, 1.0% calcium, 0.55% silicon, and 0.5% fine graphite. Comparative cooling curves are presented for the induction furnace irons along with associated data on physical properties, microstructure, and chill depth.

Small wedge-shaped castings from a blank iron and from an iron inoculated with calcium were quenched into cold water at the start of the eutectic formation and the resulting microstructures studied for difference in primary dendrite size and distribution.

The following general observations and conclusions are made. (1) The use of aluminum as a ladle addition caused a marked reduction in chill, but had very slight or negligible effect on graphite distribution and no effect on physical properties. Cell size was not changed by the late addition of aluminum and the amount of carbon and sulfur in the cast iron remained the same. Aluminum raised the temperature of the initial formation of the eutectic by about 50°F . on the average. The microstructure showed largely type D graphite. (2) Cast irons inoculated with 0.55% pure silicon were not significantly different from the corresponding blank irons. (3) The use of 0.5% of fine graphite as an inoculant raised the temperature of initial eutectic formation by about 60°F . on the average. (4) The late addition of 1.0% pure calcium metal to the ladle resulted in a cast iron that contained a large proportion of type A graphite, that showed a marked reduction in chill and in cell size, and that exhibited a definite increase in physical properties. (5) The use of ladle additions of calcium raised the temperature of initial eutectic formation by 60 - 80°F . as compared to a corresponding blank iron. The calcium inoculated irons showed eutectic cells forming from a large number of nuclei as compared to blank irons which contained relatively few centers of eutectic cell formation. The addition of calcium decarburized and desulfurized the molten cast iron and evidence was obtained to indicate that the decarburization was caused, at least in part, by the formation of calcium carbide. The size and distribution of the primary dendrites of austenite was not appreciably

changed by inoculation with calcium. (6) Strong evidence was obtained that inoculation is a nucleating process and this study points to either a carbide or a sulfide as the nucleating agent. (7) The elimination of undercooling does not necessarily result in an improvement in graphite distribution. (8) The rate of growth of the eutectic cells is an important factor in graphite shape and distribution. (9) Successful inoculation is accompanied by an elevation of the range of eutectic temperature and by a decrease in cell size. (10) The spacing of the primary dendrites, although it varies somewhat in normal and abnormal irons, cannot be taken as the principal cause of variation in graphite distribution. (11) A decrease in carbide stability as measured by chilling tendency is not necessarily related to graphite distribution. (12) The possibility exists that a group of elements related to calcium may also be effective as inoculant for gray cast iron.

102 pages. \$2.00. Mic 57-2092

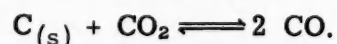
THE KINETICS OF THE DECARBURIZATION OF METALLIC COBALT IN A CARBON DIOXIDE - CARBON MONOXIDE ATMOSPHERE

(Publication No. 20,355)

Perry L. Weston Jr., Ph.D.
University of Utah, 1957

Chairman: John R. Lewis

The decarburization of cobalt was accomplished in a carbon monoxide, carbon dioxide atmosphere at 1100°, 1175°, 1250°, and 1325° C. Machined disc samples were heated in a molybdenum wound resistance furnace built for this study. The flow of CO-CO₂ gaseous mixtures was measured by a bulb-type flowmeter. The rate of decarburization was measured by determining the volume of carbon monoxide produced in the reaction,



The rate of the reaction was studied as a function of time, temperature and partial pressure of CO₂ (atmosphere composition).

A diffusion mechanism was postulated that satisfied the experimental observations. The rate of the reaction showed no CO₂ partial pressure effect, nor did the experimental observations agree with a postulated surface reaction of zero order CO₂ partial pressure.

The rate was quite sensitive to temperature and the initial carbon concentration. The heat of activation (ΔH^*) using a plot of $\ln(D/T)$ versus reciprocal temperature (T) was 35 kilocalories. An entropy of activation (5 kcal.) was

calculated using the Eyring theory of absolute reaction rates. Thus, the activation energy of this reaction was 30 kilocalories. These data agree with the literature for the diffusion of carbon in γ iron at the same temperatures.

The rate determining step of this process was considered to be the interstitial diffusion of carbon in the cobalt matrix. The absence of any carbon concentration gradient in the metallographical specimens was explained by the improbability of seeing the gradient in a cobalt solid solution, or a possible α cobalt solid solution at the surface.

89 pages. \$2.00. Mic 57-2093

INVESTIGATION OF STEADY-STATE SUBSTITUTIONAL DIFFUSION

(Publication No. 21,323)

Alfred Shui Yue, Ph.D.
Purdue University, 1957

Major Professor: Albert G. Guy

Steady-state diffusion had been studied previously in interstitial solid solutions, but not in substitutional solid solutions. The object of the present research was to study the effects of a prolonged flux of one of the components through a binary substitutional solid solution.

The particular problem chosen for study was the diffusion of zinc atoms through the alpha solid solution of zinc in copper. The experimental arrangement consisted essentially of a copper disk about 0.01 inch thick, at one of whose surfaces a gaseous atmosphere containing zinc atoms was maintained. During prolonged exposure at high temperatures the zinc content of the copper disk gradually built up to the steady-state concentration distribution and then remained at this value. The concentration-distribution curves for various conditions were determined by chemical analyses. Structural changes accompanying the diffusion process were studied metallographically.

Results were obtained from tests using three different experimental arrangements, diffusion temperatures ranging from 1430 to 1636°F, diffusion times ranging from 13 to 237 hours, and copper disks ranging from 0.0052 to 0.0189 inches in thickness. The results showed that the condition of steady-state diffusion was achieved. The diffusion coefficients calculated from the experimental data, although not of high precision, agreed with the values obtained by other workers using unsteady-state methods. Relatively slight porosity developed in the specimens in the course of diffusion.

112 pages. \$2.00. Mic 57-2094

FINE ARTS

RENAISSANCE CLASSICAL COSTUME (1450-1515) (VOLUMES I AND II)

(Publication No. 21,336)

Emma Hirsch Mellencamp, Ph.D.
University of Michigan, 1956

The purpose of this study is to investigate one aspect of the conscious attempt in the Early Renaissance in Italy to re-create classicism. Valuable evidence of this attitude is found in the desire of artists and designers to represent the classic personage in classic garb. The inevitable interpretation of Graeco-Roman fashions which resulted created a unique method of costuming important to both art iconography and theatrical costume history.

A differentiation is made between costume and fashion: fashion denoting garments worn in daily life in any century, and costume denoting garments designed or assembled for a particular and meaningful purpose. In both art iconography and theatrical activities, costumes are used for their dramatic or interpretive values as well as to indicate geographical and/or temporal distance from the given present. The "classical" garments which drape or clothe the human figures in the representations of such artists as Fra Filippo Lippi, Andrea Mantegna, Botticelli, and Piero di Cosimo are customarily considered isolated interpretations by the individual artists. But during the second half of the fifteenth century, costume designers and tailors were also called upon to produce for theatrical activities costumes which were intended to be classical in effect. The problem was common to artist and designer, to represent classic costume without classic nudity. This study correlates the costume results produced by the artists as evidenced by the iconography of their paintings, with those achieved by theatrical costumers, as described in contemporary accounts of the costumed festivals.

In Chapter I of the study, artistic and theatrical traditions in costume are presented. Three major points of reference are established from which to view the subsequent documentary material. First, that fashions merge

into types in direct proportion to their remoteness in historic time and geographic location. Second, that any interpretation of an historic fashion, in theater or in art, is dependent upon which styles are currently usual and therefore esthetically pleasing, and upon current attitudes toward decency in fashions. Third, that interpretations of historic fashions always partake as much of the period in which they were designed as they do of the temporal period they purport to re-create.

Chapters II, III, and IV correlate the artistic and descriptive evidence for the existence of a valid costume type which is termed "conventionalized classic." Chapter II, "A Uso di Ninfa," discusses the classic nymph costume as it appears in pictorial representations and as it is described in various theatrical festivities. Chapter III, "A Uso di Corazza all' Antica," discusses the "hero" in classical costume as he appears in artistic and descriptive documentation. It is found that the costumes of both the nymph and the hero were composed by excerpting various details of classical habiliment which, when overlaid upon the silhouette of contemporary Renaissance fashion, created costumes that were classic in effect to Renaissance observers, but within the limitations of esthetic idiom and social decorum. Chapter IV, "Turco-Greek Costume," is an investigation of attitudes toward Near-Eastern fashions, and of the meaning of the phrase "alla grechesca" as it applied to costume designs in the Italian Renaissance. It is found that "Greek" costume was equated with contemporary Near-Eastern fashions, both of which were timeless, and therefore included in the same category as costumes "all' antica."

Chapter V discusses the persistence of the conventionalized classic formula, pointing out that the Quattrocento had created an organic solution to the problem of representing the classic personage in classic costume. Formalized into rigid convention, the fifteenth-century solution became the dominant theatrical costume method for several centuries, until it was succeeded by the so-called "historically accurate" method of costuming.

341 pages. \$4.40. Mic 57-2095

FOOD TECHNOLOGY

SUITABILITY OF PLASTIC FILMS AS PACKAGING MATERIAL FOR HEAT PROCESSED ORANGE JUICE AND ORANGE JUICE CONCENTRATE

(Publication No. 20,875)

Heinz Chaim Mannheim, Ph.D.
University of Illinois, 1957

A study of the suitability of flexible films as containers for heat processed orange juice and orange juice concentrate was made. Relative strength of films and seams was evaluated on a test apparatus built in this laboratory. At 75° F. Saran was the strongest film followed in order by Mylar-polyethylene, Cellophane-polyethylene and Aluminum-polyethylene. At 195° F. Mylar was slightly stronger than Saran but the other films fell in the same order of strength as above. Coating film packages with acetylated monoglyceride was investigated and found to offer no advantage. The addition of several preservatives to orange juice was evaluated. Sorbic acid and sodium benzoate were found to be undesirable additives, while sulfur dioxide was advantageous in preventing juice deterioration. Juice pasteurization temperatures were determined by using pectic enzyme activity as an index. The temperatures used were 210° F. for single strength juice and 220° F. for concentrated juice.

In the main storage study the quality of orange juice products packaged in four different films was evaluated over a twenty week storage period. Storage temperature and addition of sulfur dioxide were included as variables. Canned juice products were used as controls. Other possible effects, such as presence of peel oil or pulp in the processed juice and light during storage, were studied separately. Juice quality was determined by organoleptic examinations and several objective tests. The data from these studies were analyzed by analysis of variance. It was found that peel oil, naturally present in orange juice, did not cause any flavor deterioration, and the study of orange juice pulp on flavor deterioration gave conflicting results. There was no effect of light on the quality of orange juice, nor did it interact with any of the factors studied. The addition of 200 ppm. sulfur dioxide to orange juice and storage at low temperature (36° F.) greatly retarded deterioration of the products. Juice packaged in Saran and Aluminum-polyethylene pouches was acceptable after five months storage. There was no difference in performance between these packages and cans, except that objectionable off-flavors were noticed in canned sulfited juice and in Saran packaged juice when stored at elevated temperatures. Saran and Aluminum-polyethylene pouches were significantly better than Mylar-polyethylene and Cellophane-polyethylene in this study. Concentrated juice, in general, maintained better quality than single strength juice. The difference in weight loss between pouches was significant. Cellophane-polyethylene lost most weight followed in order by Mylar-polyethylene, Saran and Aluminum-polyethylene.

It was concluded that it is feasible to package heat processed orange juice, or preferably orange juice concentrate, in pouches made from Aluminum-polyethylene or Saran. The juice in these pouches should maintain a quality comparable to that in cans during storage for at least five months at 36° F. If 200 ppm. sulfur dioxide are added to juice packaged in Aluminum-polyethylene or Saran it can be held at temperatures up to 74° F. for five months. 92 pages. \$2.00. Mic 57-2096

THE EFFECT OF THERMALLY OXIDIZED OIL AND PROTEIN ON SERUM CHOLESTEROL AND LIPOPROTEIN LEVELS, AND ON THE INCIDENCE OF EXPERIMENTAL ATHEROSCLEROSIS

(Publication No. 20,879)

Toshiro Nishida, Ph.D.
University of Illinois, 1957

The present experiments were designed to study the effect of thermally oxidized oil vs. fresh oil on experimental atherosclerosis. Furthermore, the effect of various dietary levels of protein, methionine, and choline on serum cholesterol and lipoprotein levels, and the consequent incidence of atherosclerosis was studied.

One week old chicks and ten weeks old rabbits of known genetic strain were divided into matched groups, and kept on experimental diets for a period of 4 - 10 weeks. During this period some of the animals were sacrificed for histological and chemical examination. A record of feed consumption was kept and the animals were weighed at weekly intervals.

At the end of the feeding period the birds were bled via heart puncture, the rabbits were bled by cutting the carotid artery. The blood pressure of the rabbits was measured by a direct method by cannulation before bleeding. The liver, heart, thoracic aorta, and kidney were removed immediately after sacrificing the animal for chemical and histological study. The serum lipoprotein pattern was determined with a Spinco model E analytical ultracentrifuge and the serum cholesterol was determined by the Sperry-Schoenheimer method.

The results indicated that 1) dietary protein tended to depress the atherogenic effect of dietary cholesterol and fat. It was shown that the serum cholesterol, β -lipoprotein levels, and incidence of experimental atherosclerosis in chicks were more dependent on dietary protein than on dietary fat or cholesterol. 2) Deficiency of methionine at low protein levels significantly elevated the serum cholesterol, β -lipoprotein levels of chicks, indicating that the imbalance between dietary cholesterol, fat, and methionine at the low protein levels was particularly atherogenic. 3) The substitution of thermally oxidized oil for fresh oil depressed the serum cholesterol and lipoprotein levels, but

the incidence of atherosclerosis was at least as high as with fresh oil, indicating that the serum cholesterol and β -lipoprotein levels were not necessarily proportional to the degree of atherosclerosis. 4) The rabbits which had received cholesterol and fresh or thermally oxidized oil showed no significant difference in the serum cholesterol levels. However, the blood pressure of those fed thermally

oxidized oil was significantly higher than those on fresh oil. Furthermore, the amount of cholesterol deposited in the aortas of the rabbits on thermally oxidized oil was numerically higher, and visual and microscopic inspection of the aortas indicated that those on thermally oxidized oil had a higher incidence of atherosclerosis.

94 pages. \$2.00. Mic 57-2097

GEOGRAPHY

CAMERON COUNTY: AN EMPTY AREA OF
THE ALLEGHENY PLATEAU

(Publication No. 21,148)

Charles William Boas, Ph.D.
University of Michigan, 1956

The purpose of this study is to describe a county in the Allegheny Plateau of Pennsylvania in which there are few people and much idle land. It is a detailed examination of a fragment of the "empty" lands delimited by Professor Lester E. Klimm in his article, "Empty Areas of the Northeast", published in the *Geographical Review*, July, 1952. An area such as this poses three related problems; One, what does an empty area look like? Two, what has caused the area to be empty? Three, what are the consequences of emptiness? The answers to these questions were sought largely through field study and laboratory use of recent aerial photography.

In Chapter I a detailed statement is made of the problem and the research methods employed. Site and situation considerations are discussed in Chapter II. In Chapter III the landscapes of the county are described. Most of the county is part of the rural scene in which three distinct kinds of landscapes are recognized: valleys, uplands and slopes. The valleys are characterized by relict agriculture and the presence of transportation routes. The uplands are covered by a nearly continuous forest interrupted only by a few scattered farms and hunting camps. The slopes are nearly uninhabited. The urban groupings are of three types: former lumber centers, hamlets and a single town. The first two types are marked by emptiness and decay. The town presents the anomaly of a busy industrial and commercial center in the midst of an empty area.

Chapter IV is devoted to an analysis of the causes of emptiness in the county. Of the environmental elements, landforms and drainage have exercised the greatest influence in molding the patterns of settlement. Poor soils limit agricultural activities. Climate has not been an important factor in either attracting or repelling settlement. The forest resources, however, have attracted lumbering operations in the past and today are still economically important. Although the sequent occupance has included four distinct ways of life; the aboriginal, pioneer hunting and farming, lumbering and industrial, and present patterns of settlement are remarkably similar in form to those of the earliest periods.

The consequences of emptiness are examined in Chapter V. Some of these are: a failure to attract widespread

industry, a disproportionate amount of land in public ownership, a desire to retain the wild empty land for hunting and forestry, and a decline in smaller urban groupings and rural settlement while one town grows in size and function. Perhaps the most significant finding is that the emptiness seems to attract types of land use and enterprises to which isolation is essential: thus increasing the prevalence of emptiness.

A general conclusion can be drawn from the study. The emptiness of Cameron County is not static but is actually a stage in its development. The county is less empty now than it was two hundred years ago, in another century it will be less empty still but far from closely settled.

163 pages. \$2.15. Mic 57-2098

LAND CLASSIFICATION, OWNERSHIP, AND USE
IN LEON COUNTY, FLORIDA

(Publication No. 21,153)

Harry Frederick Brubaker, Ph.D.
University of Michigan, 1956

Florida has had no comprehensive land policy: no systematic effort to guide the development of land resources in desirable directions. The purpose of this study is to examine the major characteristics and consequences of the development of land resources in one Florida county under the conditions set by this situation, with a view to making a useful contribution to the formulation of a state land resource policy.

The first chapter examines land settlement and use before the Civil War against a background of the information about land qualities and capabilities available at the time. The period was characterized by the dominance of plantation-produced cotton with slave labor. Early prosperity was followed by market difficulties leading to agricultural distress. The chapter concludes with a section on empirical land evaluations arrived at by settlers following the first four decades of use.

The second chapter deals with the period from 1865 to 1900. Scientific land classification made little progress during this time, with the only significant contributions being made by agencies of the federal government. The state produced no important studies, its publications being devoted to materials of a promotional nature derived from the writings of early observers. The tenant system replaced

slavery with little change in agricultural land use. Market troubles continued to plague cotton producers; farm diversification was urged but not attained. Trends toward absentee farm ownership and subsistence farming by tenants on plantations developed, while much land was withdrawn from cultivation. Development of forest resources near the end of the period was accompanied by a trend toward part-time farming as off-farm work became available. The chapter concludes with an analysis of the conditions of lands and forests at the end of the century, showing the period to have been one of considerable damage to these resources, with some concern expressed but no action taken.

The third chapter deals with the period from 1900 to 1950. Classification of lands according to their physical characteristics and best uses was pushed forward, largely by agencies of the federal government, and in 1950 was nearing completion. The gap between the possession and the application of this knowledge is analyzed. Continued exhortation by state agencies to improve and diversify farming had little success, and the most important agricultural trend before World War II was the general decline of farming. The profound importance of the nature and size of landholdings on change and resistance to change throughout the period is shown. A postwar trend toward livestock and dairy farming and away from harvested crops is analyzed. The continued unregulated development of forest resources and its results are noted. The chapter includes sections describing the agricultural and forest land use situations in 1950.

Conclusions drawn from the study indicate a need for the enactment of state legislation and the creation of state agencies designed to regulate resource use and to cope with resource problems before the needs become urgent. The responsibilities of specialized agencies should be clearly stipulated in order to avoid the diffusion of responsibility, overlapping of functions, and unfilled needs of the past. A state organization should be provided to integrate the administration of specialized agencies, and to coordinate their functions. 220 pages. \$2.85. Mic 57-2099

THE MINORITY GROUPS OF YUNNAN AND CHINESE POLITICAL EXPANSION INTO SOUTHEAST ASIA

(Publication No. 21,160)

Chi Jen Chang, Ph.D.
University of Michigan, 1956

This is a study of the Han-Chinese political expansion among the non-Han-Chinese tribal peoples in the Yunnan frontier area. After indicating the manner in which the tribal peoples have come under Han-Chinese control, the study presents a review of the Han-Chinese territorial expansion in its three phases: cultural colonization or Sinitization, Communist political conquest, and the implementation of regional autonomy. On the Southeast Asian countries' side of the frontier, the study contrasts the function of the frontier during the period of European colonial expansion with its function since the rise of nationalism among the countries of Southeast Asia.

As a background for an understanding of the problems involved in political expansion, and the stabilization, lat

the exploitation of the frontier, this study reviews the distribution of the different cultural groups, especially their altitudinal distribution which shows their respective cultural levels in the competition for survival. Ethnographically, the study describes the varied cultural and linguistic relationships of the non-Han-Chinese populations of Yunnan with both the Han-Chinese and the peoples of neighboring Southeast Asian countries.

Special attention is paid to the Chinese Communist technique of establishing autonomous areas and regions within the border districts, modeled on the Soviet pattern of regional autonomy for minorities. A complete list of these autonomous minority areas is given, and the distribution of each of the major minority groups is mapped in detail.

The characteristics and causes of contemporary political conflicts are presented, insofar as they bear on the problem of Han-Chinese supremacy and exploitation of the Yunnan frontier. The major conflicts concerning the presence of Nationalist Chinese troops in Burma, the "Free Thai" movement in Yunnan, the establishment of a "Free Karen State" and of a "Greater Kachin State" as well as the rise of Issarak movements in Cambodia and Laos are reviewed in detail.

In view of the existence of sparsely populated areas on the non-Han-Chinese side of the frontier, of striking ethnic similarities between tribal groups in Yunnan and in adjacent areas of the Southeast Asian countries, and the lack of cohesion among these latter, the author concludes that the present Chinese Communist technique of establishing autonomous ethnic areas in Yunnan will most likely lead to definite Chinese expansion beyond the frontier.

208 pages. \$2.70. Mic 57-2100

THE INFLUENCE OF GEOGRAPHY AND RELATED FACTORS ON THE RISE OF JAPANESE CITIES

(Publication No. 21,139)

David Henry Kornhauser, Ph.D.
University of Michigan, 1956

The purpose of this study is to examine the effect of geographic and related influences on the rise and development of Japanese cities, particularly on those factors which have led to differences in the characteristics of growth of the various urban groups. The cities of Japan by census definition are divided into large (over 500,000), medium (100,000-500,000) and small (30,000-100,000) and this study concentrates on the medium and large categories. For significant details, the characteristics of two medium, datum cities, Okayama of Okayama Prefecture and Matsuyama of Ehime, are examined throughout. The nature of urban growth in Japan reveals an almost constant pattern of a few giant city clusters towering over an urban structure made up of communities of much lesser proportions. This has been true with many changes in the order of size and importance since the 17th century, for urban Japan is far older than the Meiji Restoration of 1868.

The physical contributions of landforms, climate and weather are examined in Chapter I, followed in Chapter II by historical and political influences. Chapters III and IV deal with these forces in combination to reveal the

development of city types, both historic and modern, with especial emphasis on the role of site and function. Chapter V approaches the subject of the demographic influences of migration, emigration and general population growth of urban vs rural Japan, with particular attention paid to differential rates of growth of the three great conurbations and their satellites. Chapter VI concentrates on the modern, medium city and utilizes the two datum cities as typical of the group. The economic base is traced by showing the advantages and disadvantages of site and location. Possibilities for future expansion, especially of industry are observed and the study ends with a review of the role of the city planner on the local level.

The geographic or physical base emerges as the basic sub-structure of the whole urban framework. Cities are apparently located in the most tenable places in terms of accessibility to sea lanes, the availability of resources, protection from untoward climatic influences, etc. In addition, the plains on which they are situated are roughly in agreement with the size of the cities and are also the most easily connected by overland routes. Geography seems to have played an unusually strong role in the placement of Japanese cities. History and politics are the second most powerful factors, for such things as internal warfare, the sweeping effect of individual leaders and the resulting political and administrative machinery that grew out of feudal political stability were dominating influences on the re-orientation of city sites and the establishment of a permanent urban core. Political events in history successfully prevented the rise of many great cities until the 17th century. Modern world economic conditions forced many functional changes in the various pre-modern types of cities, but the new structure was imposed on the old in nearly

every case. Only industry and to some extent foreign trade resulted in urban forms which were unprecedented. Migration has been increasingly important in city growth and demographers generally feel the only logical course for the attempted resolving of population problems is in increased urbanization, but specifically in the diffusion of urban culture throughout the land. A possible avenue for future urban and industrial expansion may be in the medium city, which has recovered remarkably from the war and seems in point of size and numbers to be increasing in status. City planning, if properly handled, has been a potent force, especially since 1945 and should play an important part in future development.

The conclusions then are that the paramount influences to city growth have been basically physical, but strongly cultural as well. In order of importance, they could be summarized as: 1) physical, 2) historical and political and 3) economic, with the last becoming more important in late feudal times and particularly in the modern period. The traditional pattern of urban dominance by the large cities does not appear to be seriously threatened by recent events, yet the war interrupted this trend and caused greater diffusion of cities, particularly those of the medium group. By 1950 this course seemed to have some hope of permanency and perhaps of more significance in the task of spreading urban culture. It is the suggestion here that as a matter of policy the growth of medium cities be encouraged and that effort be made to overcome the obstacles to industrial development in this group in order to advance toward the goal of greater urbanization, lowered reproduction rates and possibly the eventual easing of population pressures.

189 pages. \$2.50. Mic 57-2101

GEOLOGY

SURFICIAL GEOLOGY OF THE DRUMHELLER AREA, ALBERTA, CANADA

(Publication No. 21,166)

Bruce Gordon Craig, Ph.D.
University of Michigan, 1956

The Drumheller area lies in south-central Alberta about 80 miles northeast of Calgary. The field study was carried out as part of the mapping program of the Geological Survey of Canada.

Shales and sandstones of Upper Cretaceous and Paleocene age underlie the area. Elevated plateaux, capped with Late Tertiary gravel derived from the Rocky Mountains, remain from a former Tertiary erosion surface. The gravel is thinner but more extensive than previously supposed. Comparison of this gravel with similar gravel elsewhere on the prairies indicates that it is correlative with the early Pliocene Flaxville gravel.

The Pleistocene deposits are divided on the basis of environment of deposition into four major groups that consist of glacial deposits, ice-contact deposits, lacustrine deposits, and fluvial deposits. The glacial deposits are composed of clay till deposited directly from glacial ice.

The end moraine was formed over widespread areas by processes of ablation and does not represent accumulation of debris at the ice front. Deposition of end moraine was confined to certain elevations by early stagnation at high altitudes within the area. Stagnant ice features composed of till, lacustrine sediments, and gravel occur as flat elevated areas within the end moraine. They were formed in part by deposition of water-transported material in small ice-bound lakes. Ground moraine composed of clay till covers much of the area, but on the Hand Hills the till in the ground moraine contains much Tertiary gravel. Some areas of ground moraine have been reworked by water. The ice-contact deposits are composed of material that was deposited by meltwater in juxtaposition with glacial ice. They consist of outwash, eskers, and kames, and are not extensive. Lacustrine deposits, which consist of sand, silt, and clay, were deposited in glacial-lake basins. Clay and sand are most extensive although some silt is found in the vicinity of Drumheller. The fluvial deposits consist of alluvium deposited in meltwater channels that served to drain both the melting ice and the glacial lakes. The location and shape of these channels is important in the interpretation of the glacial history.

A blue till, older than and easily distinguishable from

the common clay till, occurs in a few sections along the Red Deer and Rosebud Rivers. It is overlain locally by interglacial sand and clay till, and elsewhere has been contorted by a subsequent glacier.

The Pleistocene glaciers did not modify the preglacial topography to any great extent. Flutings and drumlinoid ridges indicate that the last glacier moved southerly to southeasterly. This glacier overrode the whole area. It retreated by northeastward melting of its margin and by local stagnation and melting on high land. The retreating margin blocked normal eastward drainage and successively lower lakes were formed as it melted back downslope and lower outlets were opened.

165 pages. \$2.20. Mic 57-2102

BIOSTRATIGRAPHIC STUDIES IN THE COMANCHE (CRETACEOUS) SERIES OF NORTHERN MEXICO AND TEXAS

(Publication No. 21,346)

Bobby Frank Perkins, Ph.D.
University of Michigan, 1956

This paper describes the biostratigraphic relationships of the Aurora limestone in the Sierra de Tlahualilo of southwestern Coahuila to the type Aurora near Ojinaga, Chihuahua and to the type Lower Cretaceous (Comanche) series of northern Texas.

Stratigraphic sections of the Fredericksburg and Washita groups in the Fort Worth-Weatherford area of north Texas are redescribed. The following stratigraphic nomenclatural revisions are proposed: (1) the division of the Goodland formation (Fredericksburg group) into two members of which the lower is designated the Marys Creek marl member (new name) and the upper the Benbrook limestone member (new name); and (2) the use of the name "Denison formation" to include the units previously referred to in the Fort Worth-Weatherford area as the Denton, Weno, Pawpaw, Main Street, and Grayson formations and here considered members. Based on the author's collections, faunal lists of the larger invertebrate fossils for each formation and member are given and the useful zonal guide fossils are indicated.

A fauna of 45 species of larger invertebrate fossils from the upper member of the Aurora limestone of the Sierra de Tlahualilo is described. Of this fauna (1), twenty-seven species are identified and (2), five are compared with species known from the Texas Comanchean; (3), two are identified with species previously known from the Mexican Cretaceous; (4), six are described as new species; and (5), six are given generic assignments only. On the basis of the stratigraphic ranges of the Texan and Mexican species with which the Aurora forms are identified and the ranges of the Texan and Mexican species allied to the new species from the Aurora it is concluded that the upper member of the Aurora limestone in the Sierra de Tlahualilo should be correlated with the Washita group of Texas. The lower part is correlated with the Fort Worth limestone and the upper part is correlated with the lowermost part of the Grayson marl. The lower part of the Aurora limestone is tentatively correlated with the Walnut marl.

This correlation indicates an upper Albian to possibly a

lower Cenomanian age for the upper member of the Aurora limestone in the area studied. Elsewhere in northern Mexico the formation has been determined as ranging from lower to middle Albian in age and only at the type area has the upper part of the limestone been considered as young as uppermost Albian or possibly Cenomanian. On the basis of this correlation it appears that the environment responsible for the origin of the Aurora limestone did not appear everywhere in northern Mexico at the same time nor did it persist for an equally long period at every place in the region.

The Aurora limestone is interpreted as a formation of epineritic origin deposited far from a source of clastics as indicated by the fauna and by the almost complete absence of terrigenous material within this unit. This origin is in contrast to that of the Fredericksburg and Washita groups in north Texas where the strata of these groups are principally epi- and infraneric in origin as shown by the faunas and the abundance of fine-grained clastics throughout the strata.

298 pages. \$3.85. Mic 57-2103

GEOLOGY OF CENTRAL ARAGUA, VENEZUELA

(Publication No. 20,154)

Reginald Shagam, Ph.D.
Princeton University, 1956

The central Aragua area is located on the southern flank of the mountain ranges of north central Venezuela. The south boundary of the map area is a geologic and physiographic boundary marking the separation between the mountainous metamorphic zone to the north and the low hills and plains of the "llanos" underlain by unmetamorphosed rocks to the south.

The major part of the area is underlain by a sequence of metamorphosed volcanic rocks, in excess of 2000 meters thick, collectively named the Villa de Cura group. This sequence has been subdivided into four conformable formations. The lower three (El Caño, El Chino, El Carmen) consist of metamorphosed spilitic basalts and associated volcanic sedimentary rocks. These rocks are now greenstones composed of an intergrowth of epidote, actinolite, quartz, chlorite, and albite. Glaucophane is present in some rocks. A striking feature of the lavas is the presence of unaltered augite. The uppermost (Santa Isabel) formation is considerably more siliceous than the lower three formations. The constituent rocks are chlorite schists, quartz-albite-granulites, and epidote-chlorite-quartz-albite schists. Many rocks contain glaucophane. The Santa Isabel rocks closely approximate keratophyre lavas in chemical composition but are clearly of sedimentary origin.

Rocks of dioritic composition intruded the Santa Isabel formation before the main metamorphic episode.

Outcropping to the north of the Villa de Cura group is a sequence of carbonaceous phyllitic-schists and metamorphosed quartzose lithic wacke sandstones and conglomerates, and a distinctive black fine grained limestone with large clastic calcite grains. This sequence has been named the Tucutunemo formation and is considered to be the uppermost member of the Caracas group of meta-sedimentary rocks and to lie conformably above the Las

Mercedes formation. Of the Caracas group only the Tucutunemo formation outcrops in the map area. The Tucutunemo formation and the Villa de Cura group are possibly of contemporaneous age having been deposited in two areas separated by a topographic high. Scanty paleontological evidence suggests an Early Cretaceous age for the Caracas group and hence for the Villa de Cura group.

In mid-Cretaceous times the main crustal deformation took place, accompanied by the intrusion of ultrabasic rocks. The grade of metamorphism attained was not greater than that represented by the albite-epidote-amphibolite facies of regional metamorphism.

The deformation was followed in pre-Coniacian time by the extrusion of another series of spilitic basalts and tuffs referred to as the Tiara formation. Its lavas are texturally and mineralogically distinct from those of the Villa de Cura group.

The Arrayanes formation on the southern boundary of the map area is largely composed of Tiara pebbles. It consists of lithic wacke siltstones, sandstones, and conglomerates. A Coniacian ammonite found near San Juan de los Morros provides the oldest positive dating of rocks in the map area. Neither the top nor the bottom of this formation have been observed.

In Maestrichtian to Paleocene times there was a continuous episode of deposition of calcareous lithic wacke siltstones and sandstones, and aphanitic foraminiferal limestones. The Maestrichtian sequence in the present mountain belt is referred to as the Paracotos formation. A second weaker deformation began after the deposition of the Paracotos formation and continued into Paleocene time, contemporaneously with deposition. The Tiara and Paracotos formations were caught within the deforming structure and suffered mild dynamic metamorphism. The Arrayanes and Maestrichtian - Paleocene rocks to the south were merely carried northwards on the south limb of this structure and were unaffected by the metamorphism.

In post-Paleocene time normal faulting, possibly in response to isostatic readjustment, took place. This faulting was accompanied by solid re-injection of the ultrabasic rocks.

The dominant structural trend of N 75 E is explained on the basis of compression acting along a NNW - SSE direction. This compression could have been a resultant of an E-W shear couple produced by the movement of the Caribbean block eastwards into the deforming arcuate tectogene.

145 pages. \$2.00. Mic 57-2104

THE GEOLOGY OF TERRACE AREA, COAST DISTRICT, BRITISH COLUMBIA

(Publication No. 20,158)

Jack Gordon Souther, Ph.D.
Princeton University, 1956

Terrace map area covers approximately 3000 square miles in the Coast and Hazelton mountains of western British Columbia. It is underlain in the west and southwest by rocks of the Coast Range batholith; in the east and northeast by not less than 18,000 feet of sedimentary and volcanic strata which range in age from Permian to early Cretaceous.

Fossiliferous Permian limestone is overlain unconformably, but without marked angular discordance, by some 1000 feet of limestone-boulder conglomerate, graywacke, and shale which are believed to be of Triassic age. These are overlain conformably by predominantly volcanic rocks of the Hazelton Group (Jurassic) which, in Terrace area, has been divided into two units: (1) a lower unit, approximately 3000 feet thick, consisting of coarse andesite breccia intercalated with minor graywacke, (2) an upper unit, at least 4000 feet thick, consisting of porphyritic and amygdaloidal andesite flows. A marked angular unconformity separates these rocks from overlying marine and terrestrial sediments of late Jurassic-early Cretaceous age.

The above assemblage is intruded by the Coast Range batholith. The main granite contact trends northwesterly but is extremely irregular, sending out apophyses from five to fifteen miles long, which project in a northeasterly direction, nearly at right angles to the regional structural trend. Each of these apophyses forms the core of a breached anticline, the oldest rocks appearing along the flanks of the intrusion. At least one of these bodies is believed to have been emplaced by lateral injection of magma.

Metamorphism of the country rock is confined to a relatively narrow zone adjacent to the batholith. Alteration is most intense against the main body of the batholith where quartz-biotite schist and hornblende-quartz-plagioclase gneiss have developed. Around apophyses and outlying stocks metamorphism is of the lowest grade.

The batholithic rocks have been divided into four igneous rock facies: (1) the Gabbro Facies, (2) the Pyroxene Quartz Diorite Facies, (3) the Inner Facies, and (4) the Border Facies. The first two are relatively basic assemblages emplaced early in the magmatic history of the region. Olivine-bearing gabbro of the gabbro facies has been intruded by biotite granodiorite of the main batholith. Reactive assimilation of the gabbro by the granodiorite magma has given rise to an intermediate zone of hornblende quartz diorite containing relict minerals derived from the gabbro.

Rocks of the pyroxene quartz diorite facies are confined to one of the northeast trending apophyses which was emplaced before the main batholith. The body is concentrically zoned with respect to its contacts. A border phase of pyroxene quartz diorite grades through granodiorite and adamellite phases into a central granophyric phase. Locally the central phase forms intrusive and replacement dikes which cut the outer phases and extend into the country rock. Mineralogical and textural variations suggest that the zoning is due to differentiation in situ of an initially fluid magma. Concentration of volatiles in the inner, residual portion of the intrusion reduced the viscosity of this phase sufficiently to permit its intrusion into the solidified outer shell and beyond.

The inner facies comprises the central core of the main batholith which, in Terrace area, is made up of three distinct ages of biotite granodiorite-adamellite, each of approximately the same composition. They are differentiated on the basis of color, texture and degree of deuteric alteration. The inner facies is considered to be purely magmatic, having been emplaced as a crystalliquid melt at high temperature.

Surrounding the inner facies in a zone of complex mixed rocks, the border facies, in which hornblende is the dominant mafic mineral. This zone is divided into three

sub-facies, each with a definite spatial relationship to the main body of the batholith: (1) the hornblende granodiorite, gradational with biotite granodiorite of the inner facies, (2) hornblende pseudo-diorite, gradational with the country rock, and (3) the migmatite zone, intermediate between the first two. All of these rocks are believed to be the products of interaction between fluid magma or its associated volatiles and the country rock. Transitions between the various sub-facies and between the pseudo-diorite and the country rock are usually gradational, however, pseudo-diorite and migmatite are locally in sharp intrusive contact with relatively unmetamorphosed wall rock. This is attributed to mobilization of the hybrid rock and its intrusion into a higher level.

221 pages. \$2.90. Mic 57-2105

GEOLOGY OF THE KEMANO-TAHTSA AREA, BRITISH COLUMBIA

(Publication No. 20,160)

Roy Armstrong Stuart, Ph.D.
Princeton University, 1956

The Kemano-Tahtsa map-area is located geographically in central western British Columbia; physiographically in the Coast Mountains and the transition zone between the Coast Mountains and the Nechako Plateau; and geologically in the eastern contact zone of the Coast Range Intrusive Complex. It includes an area of approximately 180 square miles underlain by igneous, volcanic, sedimentary, and metamorphic rocks ranging in age from pre-Middle Jurassic (probably Early Jurassic) to post-Early Cretaceous.

The oldest rocks exposed in the map-area occupy the core of a large dome and comprise a complex assemblage of hornblende meladiorite and diorite, quartz diorite, leucogranodiorite, adamellite, and basic dike material. Structural and chemical data indicate that the meladiorite, diorite, and quartz diorite are genetically related and suggest that they are differentiates of a common parent magma. Structural data relating the leucogranodiorite and adamellite to the same parent magma are lacking, but certain chemical and mineralogical peculiarities common to all of the rocks in the complex suggest that such a relationship does exist.

The igneous complex is overlain unconformably by Middle Jurassic rocks of the Hazelton Group. In the eastern part of the map-area these rocks consist of unmetamorphosed andesitic volcanics; in the western part they consist of metamorphosed volcanic and sedimentary rocks. Metamorphic rocks of the greenschist facies flank the igneous complex on the west and southwest, and represent a regional metamorphism probably contemporaneous with intrusive igneous activity west of the Kemano-Tahtsa area. Rocks of the amphibolite facies flank, and are related to, several intrusive bodies within the map-area.

Upper Lower Cretaceous sandstones and shales unconformably overly the Hazelton volcanics in the easternmost part of the map-area.

A number of igneous bodies that exhibit a range in composition from hornblende gabbro to adamellite and albite granite intrude the Hazelton and older rocks. They are probably all related to the Coast Range Intrusive Complex but most are small isolated bodies with no apparent direct

connection with the main mass of the Complex, which lies to the west. One, however, a quartz diorite-granodiorite batholith projecting a short distance into the northern part of the map-area, may represent a lobe of the Coast Range "Batholith," and another, which consists of quartz dioritic gneisses and occupies the westernmost part of the map-area, may represent the eastern border zone of the "Batholith."

The major chemical components of rocks representing all but one of the various post-Hazelton intrusive bodies fall on variation curves that are either coincident with or are smooth extrapolations of variation curves for one of the bodies, a large dike that has differentiated in place. This suggests that the rocks are genetically related and have been produced by progressive magmatic differentiation, a suggestion supported by the sequence of intrusion of the different rock types -- from the more basic to the more acid varieties. Even stronger support is provided by the distribution of trace elements in two of the intrusives, which are composed of rocks ranging in composition from diorite to adamellite, and which together include equivalents of most of the post-Hazelton rocks present in the area. In these two intrusives, rocks of equivalent major oxide compositions have equivalent trace element compositions. Further, the trends of trace element variations accompanying systematic major oxide variations in the more basic of the two are continued without interruption in the more acid. The trace element compositions of rocks of a consanguineous magmatic series are much more likely to be unique to that series than are the major oxide compositions, and relations such as those exhibited by the rocks under discussion offer very strong evidence for consanguinity.

Structural features representative of several different types and ages of deformation are present in the Kemano-Tahtsa area. The earliest recognized deformation is represented by strong shearing and fracturing that is present in the diorite, meladiorite, and quartz diorite of the pre-Middle Jurassic igneous complex but not in the leucogranodiorite and adamellite. There is no evidence for further strong pre-Middle Jurassic deformation, but a post-Middle Jurassic pre-late Early Cretaceous regional folding, probably contemporaneous with intrusive activity west of the map-area has produced a series of north-northeast trending folds in Hazelton strata. The dome in which the pre-Middle Jurassic rocks are exposed is younger than late Early Cretaceous, and was apparently formed by vertically-directed forces during the time that the post-Hazelton intrusive masses within the map-area were emplaced. The intrusive activity within the Kemano-Tahtsa area is therefore most probably post-late Early Cretaceous.

166 pages. \$2.20. Mic 57-2106

STUDIES ON PETROLEUM WITH THE ULTRACENTRIFUGE

(Publication No. 20,896)

Paul Adams Witherspoon, Jr., Ph.D.
University of Illinois, 1957

The question of whether or not colloidal particles exist in petroleum has long been a fundamental problem. There

is a lack of unequivocal evidence and often a confusion of conflicting statements in the literature.

An apparently new approach to this problem is to use the ultracentrifuge and impose a gravitational field sufficient to separate colloidal particles from petroleum. Extensive studies have been carried out with the ultracentrifuge on one Mississippian crude oil from the Illinois basin, and additional work has been done on a Pennsylvanian and a Devonian sample from the same basin. A California crude oil of Pleistocene age also has been studied briefly.

Prolonged centrifugation of the Mississippian oil has demonstrated that at least three different groups of colloidal particles are dispersed in the oil. One group that has been separated from the oil is an organic sediment and has been identified as asphaltene. Analytical centrifugation work indicates that the density of these asphaltene particles is 1.22 g/cm^3 . Assuming that the asphaltene particles are spherical and that the degree of solvation is not an appreciable factor, the average particle size is calculated to be 40 \AA . Similar results were obtained with the other two Illinois oils. It is suggested that 40 \AA may be a unit particle dimension for the asphaltene. A molecular weight of 30,000 was obtained for this material.

Less specific data are given for the nature of the other two groups of colloidal particles that were segregated within the Mississippian oil but not separated from it. A

method of isolating these fractions for more quantitative study is proposed.

The occurrence of discrete asphaltene particles in these three Illinois crude oils is consistent with the fact that Illinois oils generally are somewhat asphaltic. The important implication, however, is that, because asphaltic materials are commonly present in petroleum, practically all crude oils contain colloidal particles. It is anticipated from this work that crude oil contains several different groups of colloids.

In addition to the organic sediment that was centrifuged from the Illinois crude oils, a very minor amount of inorganic sediment also was obtained. Electron micrographs of this material revealed a significant amount of clay particles. Although no organic sediment could be centrifuged from the California crude oil because of its extremely high viscosity, it yielded significantly more inorganic sediment than did the Illinois oils. The inorganic sediment from the California crude contained a substantial amount of clay-like particles. It is postulated that investigations of these clay materials and of the various groups of organic colloids in crude oil may provide important information on the genesis of petroleum.

Use of the ultracentrifuge thus provides an important new approach to fundamental research on the colloidal nature of petroleum. 162 pages. \$2.15. Mic 57-2107

HEALTH SCIENCES

HEALTH SCIENCES, DENTISTRY

A PHOTOELASTIC ANALYSIS OF THE STRESSES DEVELOPED IN A RESTORED PRIMARY TOOTH WHEN SUBJECT TO FORCES OF MASTICATION

(Publication No. 21,331)

David Bernard Mahler, Ph.D.
University of Michigan, 1956

The purpose of this investigation was to determine the optimum design of a disto-occlusal restoration in a primary mandibular first molar with particular emphasis on evaluating the criterion of resistance to internal stress. The problem was divided into two phases; one dealing with the stress analysis of the restoration and the other, the stress analysis of the tooth. This investigation was undertaken due to 1) the reported failure of this restoration and remaining tooth structure, and 2) the variation in design as stipulated by different investigators.

A general discussion of the criteria for restorative design was presented and included considerations of (1) external tooth morphology, (2) internal tooth morphology, (3) extension for prevention of further decay, (4) operating access and instrumentation, and (5) retention of the restoration. All of these factors were considered in the design features studied. The criterion of resistance to internal stress or prevention of failure was discussed separately since it served as the basis for this present study.

Criteria for failure relate the stresses in the structure

to the strength properties of the materials from which the structure is made. For a rigorous analysis, these criteria should be utilized. However, the heterogeneity and anisotropy of tooth structure as well as the complicated configuration of the tooth disallow a quantitative substitution into the failure criteria. Therefore a comparative approach was used in which the various designs were evaluated relative to each other to establish which configurations produced the most favorable stress response in the structure. The method of Photoelasticity was used to determine the stresses in the structures and attention was focused on those types of stresses which would result in failure for the type of material involved (brittle or ductile) and the method of loading the structures (rate of loading and/or static versus cyclic loading). For amalgam, the maximum tensile stress was investigated where it occurred in the structure. For tooth structure, the maximum shear stress was investigated. These types of stresses were investigated on the basis of previously reported results on the plastic behavior of materials.

Since failure has been observed in the restoration at the isthmus, those factors which reduced the tensile stress in this region were investigated. The regions of the gingival floor and the buccal and lingual walls of the cavity were investigated from the standpoint of the tooth. The most significant conclusions which were deduced from this study are (1) The maximum tensile stresses occur in the restoration at the occlusal surface and decrease as the plane of the axial wall is approached. (2) Sloping the axial wall produces a more favorable response in the restoration

than alteration of the pulpal floor design. (3) Leaving the restoration as high as possible and still providing clearance with respect to the maxillary cusp produces a more favorable response in the restoration than alteration of the pulpal floor design. (4) Increasing the width of the restoration at the isthmus results in unfavorable stresses in the buccal and lingual walls of the restoration. (5) Decreasing the width of the dentin over the pulp chamber as a result of pulpal floor design, results in increased bending of the buccal and lingual walls of the tooth. (6) Contouring the restoration to conform to the maxillary cusp results in a reduction in shear stresses in the buccal and lingual walls of the tooth. (7) Adjusting the occlusion produces a more favorable response in the restoration than any of the other factors investigated. 140 pages. \$2.00. Mic 57-2108

HEALTH SCIENCES, PHARMACY

A STUDY OF THE EFFECTS OF CERTAIN MINERAL DEFICIENCIES ON METABOLISM AND ALKALOID BIOGENESIS IN *DATURA STRAMONIUM* L.

(Publication No. 20,367)

Maurice Clement Andries, Ph.D.
University of Washington, 1956

A study was undertaken to determine the effects on alkaloid biogenesis in *Datura stramonium* L., as related to amount of free amino acid, protein, and total nitrogen in the older and the younger leaves of plant groups. The groups were cultured in nutrient solutions deficient in calcium, potassium, nitrogen, and phosphorus, and in rich soil, both in the greenhouse and also in the field.

Documented methods were used to analyze all dry leaf samples, with verification for validity of modifications made submitted as determined, with standards.

Datura leaves from soil control groups, compared with leaves from solution control groups, are found to biosynthesize approximately six times more tropane alkaloid, but contain almost 14 per cent less total nitrogen, while all controls are identical in amount of amino acid formed, and show no significant difference in protein content.

A calcium concentration of 80 parts per million (p.p.m.) in the plant nutrient solution medium, half that in the control concentration, is associated with increasing alkaloid and amino acid biosynthesis, and decreasing total nitrogen and protein formation. However, with calcium concentrations of 40 p.p.m. and 1.6 p.p.m. in nutrient solutions, alkaloid decreases, increase in free amino acid continues, and protein increase is apparent.

Potassium, when used 117 p.p.m., half that of the control solution concentration, stimulates alkaloid formation 34 per cent, causes significant decrease in total nitrogen and amino acid, but protein content changes little. However, with sharply lower concentrations (58.5 and 2.34 p.p.m.) of potassium, total nitrogen decreases slightly, but alkaloid, amino acid, and protein biosynthesis all lower significantly.

With nitrogen, used 52.5 p.p.m., one-fourth that of the control solution concentration, an increase in alkaloid is

of doubtful significance, but total nitrogen and protein decrease by almost one-third, and the amino acid decrease may be significant.

When phosphorus deficiency is 0.31 p.p.m., or one one-hundredth that of the control solution concentration, biosynthesis of alkaloid increases more than 85 per cent, while total nitrogen decreases by one-fifth, but amino acid and protein decreases are insignificant.

Datura under field conditions do not grow as tall as greenhouse-grown plants, but do have larger, stronger stems and larger, thicker, darker green leaves. Field-grown leaves, when dried, generally lose less of their green weight. Dry weight of all leaf groups approximates 10 to 12 per cent of the green weight. Younger leaves have approximately one-half the ash content older leaves assay. Younger leaves accumulate five times more total alkaloid, but older leaves retain in excess of seven times more leaf calcium.

With a brief review of published concepts on possible metabolic pathways that might be involved in the biogenesis of alkaloids, an amino acid-enzyme-alkaloid pathway is now suggested in which operation of the induced, adaptive, and inactive enzyme mechanisms may give rise to intermediates leading to synthesis of alkaloids. Function of these mechanisms, inherent in the multiple enzyme systems in *Datura*, apparently varies with the plant's metabolism. This, in turn changed within limits by a varying complex of excess mineral nutrients as in a rich soil medium, or by a limited decreasing concentration of a specific mineral below the normal control concentration as in nutrient solution media used, in each instance appears to increase synthesis of alkaloid.

Experimental findings seem to support this, and it is submitted to possibly explain the change in rate of alkaloid biosynthesis in *Datura*.

109 pages. \$2.00. Mic 57-2109

A CONDUCTOMETRIC STUDY INVOLVING SOME SALTS IN THE GLACIAL ACETIC ACID SYSTEM

(Publication No. 21,222)

Boen Tong Kho, Ph.D.
The University of Wisconsin, 1957

Supervisor: Professor Takeru Higuchi

The degree of dissociation of the alkali acetates and the alkaline earth acetates in glacial acetic acid can be predicted by Bjerrum's equation. The smaller the cationic radius, the lower the degree of dissociation or the specific conductance. The specific conductivities of the alkali acetates are known to be in the following order potassium > sodium > lithium. In the case of the alkaline earth acetates the order is barium > strontium > calcium > magnesium. The acetates, which essentially are bases in glacial acetic acid, behave entirely differently than the salts. The order of the conductivities of the alkali perchlorates is lithium > sodium > potassium and of the alkaline perchlorates is magnesium > calcium > strontium > barium.

A minor factor contributing to this anomalous behavior of salts in acetic acid is the difference in the degrees of

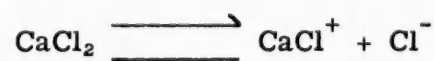
solvolysis of the salts involved. The smaller the cationic radius, the higher is the degree of solvolysis. Relative to the indicator base malachite green magnesium perchlorate is 27 times more acidic than barium perchlorate. However, the radius of the magnesium ion is roughly only one half of the barium ion. Experimentally it has been proved that solvolysis is not the only factor governing the behavior of inorganic salts in glacial acetic acid.

Another very important factor is probably solvation. The degree of solvation of the salts with common anion is higher as the radius of the cation decreases. A larger degree of solvation favors a higher degree of dissociation. Bjerrum(1) neglected entirely the solvation phenomena in the derivation of his equation, relating dissociation constant to dielectric constant, temperature and ionic size. This is the main reason why his equation leads to erroneous results when applied to salts in glacial acetic acid. The anion of a base in glacial acetic acid being the same as that of the solvent, ion-dipole interaction is negligible and therefore, Bjerrum's equation is obeyed, in the case of bases.

When the alkaline earth acetates were titrated with perchloric acid, a maximum in the conductometric titration plot occurs before the endpoint is reached. This phenomenon can be explained on the basis of triple ion formation and dissociation.

The sulfate salts are known to be insoluble in acetic acid, indicating that the degree of solvation is negligible. Bjerrum's equation is therefore obeyed in the case of the alkali sulfates and the alkaline earth sulfates.

It was also found that the sodium chloride ion pair and the lithium chloride ion pair were dissociated into a sodium and a lithium cation and a chloride anion. The calcium chloride triple ion dissociates in the following manner:



However, magnesium chloride, having a smaller cation than calcium chloride, behaves entirely differently and higher aggregates are probably involved.

When the alkaline earth acetates were titrated with hydrobromic acid, the conductometric titration plots resemble those of the alkaline earth perchlorates.

Some practical applications were discussed. Magnesium perchlorate, calcium perchlorate and strontium perchlorate react in a one to one ratio with inorganic sulfates or organic sulfates in glacial acetic acid, the endpoints being determined by potentiometric or conductometric means.

131 pages. \$2.00. Mic 57-2110

A STUDY OF THE EFFECTS OF ATROPINE AND 2,4-DICHLOROPHENOXYACETIC ACID ON THE GROWTH AND ALKALOID FORMATION IN MEMBERS OF THE SOLANACEAE

(Publication No. 21,209)

Leo Anton Sciuchetti, Ph.D.
University of Washington, 1957

A study has been made of the effects of toxic concentrations of atropine and 2,4-D on the plant growth and in leaf accumulation of atropine in Datura stramonium and

Lycopersicon esculentum. The plants were grown in hydroponic cultures. The atropine was administered by addition to the culture media and the 2,4-D was applied in the form of a spray to the leaves. The following salient points were observed:

Characteristic responses were induced in both plant species by treatment with atropine. These consisted of severe leaf wilt, leaf roughening, loss of lower leaves, and root browning. Further, a characteristic necrotic behavior of the leaf tissue of tomato was noted. The 2,4-D effect in *Datura* and tomato consisted of stem epinasty, leaf curl and leaf roughening. The responses appeared much slower in tomato. In general, both types of injury, though less extensive, were induced in both species by the combined 2,4-D and atropine treatment.

An inhibitory effect from the various treatments was demonstrated for *Datura* in dry weight comparisons. Significant decreases in total dry weights were displayed by all the treatments with the exception of the plants receiving 2,4-D only. Erratic responses were noted in tomato since both increases and decreases in dry weights were observed. Both species demonstrated lower leaf-stem ratios than control plants as a result of the various treatments. This would indicate that leaf and top growth was inhibited more than stem growth or, alternatively that translocation was altered. The changes in shoot-root ratios were correlated somewhat with the observed toxic effects of the treatments on the plant organs.

Significantly decreased water uptakes were noted in *Datura* under the influence of atropine (alone or combined). The decreased water uptake due to the 2,4-D only was not considered significant. In general, similar trends were observed in tomato. There was a correlation between water uptake and inhibition of growth in *Datura*. The rate of atropine uptake in *Datura* treated with atropine alone was rapid initially and very slow thereafter. The rate for the plants receiving the combined treatment demonstrated a lag period effect. Similar but less pronounced trends were observed in tomato.

Significant increases in leaf accumulation of alkaloids were induced in both species by the atropine treatments (alone or combined). At the higher atropine concentration the increases per plant leaves-tops amounted to approximately 24-fold and 158-fold in *Datura* and tomato, respectively. Under the influence of 2,4-D about a 14.0 per cent decrease was shown in *Datura*, but this was not considered significant.

Considerable changes in hyoscyamine/scopolamine ratios were noted in leaf alkaloid accumulations in *Datura*. The suggestion was that 2,4-D may have had an influence on these changes. In tomato it appeared that most of the atropine absorbed from the culture media accumulated in the leaves and tops to a large extent unchanged.

In both plants the atropine absorption under the influence of the combined treatment was less than with atropine alone. However, the decreased absorption was not considered significant. There was a significant uptake of atropine alkaloid in *Datura* under conditions of the 0.25 per cent atropine treatment. For example, about 23.9 per cent of the absorbed atropine accumulated in *Datura* leaf tissue compared to about 10.5 per cent with the combined treatment. The decreased accumulation due to the combined treatment was considered significant.

179 pages. \$2.35. Mic 57-2111

TIN AS AN ANALYTICAL REDUCING AGENT IN GLACIAL ACETIC ACID

(Publication No. 21,229)

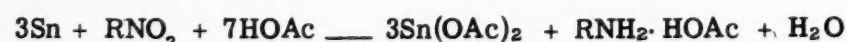
Natverlal Dahyabhai Shah, Ph.D.
The University of Wisconsin, 1957

Supervisor: Professor Takeru Higuchi

The present investigation was concerned with the behavior of metallic tin in glacial acetic acid in the presence and absence of air, and the reductive behavior of tin in acetic acid and the application of this system to quantitative determination of some functional groups. The groups studied were nitro, nitroso, organic nitrites and nitrates and aldehydes. Nitro, nitroso and azo compounds on reduction gave quantitative yields of corresponding amines. These were titrated potentiometrically with perchloric acid using a Beckman Model G pH meter. A sleeve calomel electrode and a glass electrode was the electrode system used for the study. The method was found to be good for the quantitative determination of nitro, nitroso, and azo compounds. Nitrates though reduced, did not give a quantitative yield of the basic reduction product ammonia. Nitrates on reduction gave only sixty per cent of the theoretical amount while aldehydes could not be reduced at all.

Tin in acetic acid presented an interesting system for investigation. It did not evolve hydrogen with acetic acid. It did not react with acetic acid in absence of air, but it did in presence of air. Also presence of an oxidizing agent like nitro compound was necessary for the reaction of tin and acetic acid to occur. The tin metal was converted into a white amorphous precipitate which appeared to be an acetate of tin with a probable structural formula of $\text{Sn}(\text{OAc})_2$.

Tin reacted stoichiometrically with nitro compound, three atoms of tin being used up per mole of nitro group. The reaction between tin, acetic acid and nitro compound can be written as



This stoichiometry determinations were done under strict nitrogen atmosphere. When the solution containing unreacted tin, the precipitate and the reduced product was filtered and left standing a white precipitate started coming out of the once clear solution. It seemed that the stannous acetate present in the solution reacted in part with oxygen to form the precipitate. The precipitate was found to contain about 47 per cent tin, out of which 31 per cent was stannous the rest being stannic, and about 49 per cent of acetate as acetic acid. Both stannous acetate and the precipitate were not titratable with perchloric acid and hence did not interfere with the amine perchloric acid titration of the compounds.

The tin-acetic acid system as a reducing agent for the nitro, nitroso and azo groups studied had the following advantages over the previous methods. (1) Presence of air did not interfere with the quantitative determination of the compounds, (2) it was good for the quantitative determination of all the nitro, nitroso and azo compounds studies, and (3) it was accurate within ± 1 per cent.

99 pages. \$2.00. Mic 57-2112

A COMPARISON OF THE EFFECTS OF COLCHICINE AND SOME PURIFIED VERATRUM ALKALOIDS ON NUCLEAR DIVISION IN ROOTS OF ALLIUM CEPA L.: WITH PRELIMINARY OBSERVATIONS ON GERMINATION, ROOT LENGTH, AND ENVIRONMENTAL FACTORS

(Publication No. 18,704)

Douglas Lee Smith, Ph.D.
University of Utah, 1956

Chairman: L. David Hiner

This study represents an investigation and comparison of the effects of various Veratrum alkaloids on nuclear mitotic division in an effort to determine 1. whether some purified alkaloidal mixtures or crystalline alkaloids possess the ability to modify the cycle of nuclear and cellular division, and 2. to determine how such activity compares in kind and degree to that already well established for colchicine. In addition, preliminary studies have been conducted to determine what effect a number of other physical and chemical factors have on nuclear mitotic division being studied in order to eliminate their influences as experimental variables.

Onion bulbs, Allium cepa var. White Portugal, were used as the experimental plant. Roots were sprouted on the bulbs using tap water and experiments were conducted under constant temperature ($30^\circ\text{C}.$ $\pm 0.5^\circ\text{C}.$) conditions. Roots from 1.5 to 6.0 cm. in length were used for all observations of nuclear division. Microscopic examination of the cells was performed by a root tip smear method in which root tips were killed and fixed for 24 hrs. or longer, softened to separate the individual cells, rehardened, stained, and observed through a microscope at a magnification of 440 diameters. All intact cells observed in a predetermined area of a glass slide, either resting or in any stage of mitotic nuclear division were recorded and the per cent of cells in the process of nuclear division at the time of observation was calculated. Suitable statistical techniques were employed (chi-square, linear regression, and analysis of variance) to analyze the experimental results and permit conclusions to be drawn therefrom.

No significant differences were noted from control values in nuclear division between times of exposure of 3 and 6 hrs. to a 2 per cent solution of 2-chloroethanol. Three hr. bulb soaking failed to stimulate germination of a significantly greater number of bulbs than was produced by tap water alone; however, production of new roots was significantly increased over results observed for tap-water controls. These data suggest that pre-soaking periods for Allium bulbs are not harmful to nuclear mitotic division. Further, the agent appears to be incapable of breaking bulb dormancy in the concentration used and for the soaking time employed but is highly effective in increasing the germination rate of new roots from non-dormant bulbs (approximately 19 per cent over control values).

Although there was no significant difference in overall nuclear mitotic division between roots up to 7.5 cm. in length, very short roots (up to 1.0 cm. in length) were consistently low (2.4 per cent) in the number of dividing nuclei from that of the control (4.0 per cent) which suggests that short Allium roots up to 1.0 cm. long increase in length more from cell elongation than by meristematic

mitotic production of new cells. To eliminate the influences of root length on nuclear division as an experimental variable, only roots from 1.5 to 6.0 cm. long were used for all observations.

In a population sample of 40 *Allium* bulbs the number of mitotic dividing nuclei was not significantly changed for different times of day when observations were performed on roots obtained every 3 hrs. over a 24 hr. period of time. The effects of light, intermittent light, and darkness on nuclear division and root length over a 72 hr. test period indicated that prolonged exposures to artificial light had a noticeable but non-significant inhibitory effect ($P > .05$) on mitotic nuclear division and a marked inhibitory effect on root length ($P < .001$). In order to eliminate the influences of light as an experimental variable on the number of mitotic dividing nuclei, *Allium* roots should be exposed to known intensities of light which may be controlled at all times.

Exposure of *Allium* roots to 7 different temperature gradients from 15 to 45°C. in increments of 5°C. for 24 hrs. revealed that the mean number of mitotic dividing nuclei exposed to 20, 25, 30, and 35°C. were not significantly different from the mean values obtained from roots exposed to the control temperature (30°C.), whereas means at temperature extremes of 15, 40, and 45°C. differed significantly (40 and 45°C., $P < .01$) from controls. This suggests that rather wide temperature fluctuations may be permitted without producing undesirable alterations in mitotic nuclear activity. Temperature extremes, however, may have marked effects on mitotic processes; therefore, whenever possible, experiments should be conducted under well controlled temperature conditions.

Examination of *Allium* bulbs treated with concentrations of colchicine of 0.1, 0.2, 0.4, or 0.8 per cent for predetermined periods of time of 3, 6, 9, or 12 hrs. revealed that the time and concentration factors both caused significant changes in nuclear mitotic division from control values. Independent of the time factor, all colchicine concentrations had an inhibitory effect. When time was examined as the major variable, significant differences in

nuclear mitotic activity were also observed. The data also showed the existence of a significant interrelation between the effects produced by the time and concentration factors. Typical colchicine-mitotic (c-mitotic) effects were produced with all colchicine concentrations employed. The data suggests that colchicine, studied by these experimental methods, is capable of modifying nuclear mitotic activity by producing typical c-mitotic changes in the chromosomes of *Allium* roots. Successful inhibition of the spindle apparatus may be achieved and polyploid cells ($2n = 32$) are prominent. When using colchicine experimentally, not only must the concentrations be taken into account but also the exposure time must be considered.

The effects produced by Veriloid, a standardized mixture of hypotensively active alkaloids present in *Veratrum viride* Ait. were examined in *Allium* bulbs treated with acidified solutions which contained concentrations equivalent to 0.1, 0.2, 0.4, or 0.8 per cent of Reference Standard Alkavervir (Riker Laboratories) in fresh tap water for predetermined periods of time (3, 6, 9, or 12 hrs.). The data suggests that alkaloidal agents present in *Veratrum viride* have an effect on nuclear mitotic division in roots of *Allium cepa* L. Chromosomal aberrations were frequently observed although their appearance suggested a markedly different mode of action than that observed with colchicine. Polyploid cells may be noted and the effects on nuclear mitotic division are in agreement with those reported by Witkus and Berger (1944) for veratrine, an alkaloidal mixture obtained from a different plant source (*Schoenocaulon officinale* A. Gray) but whose constituents are structurally similar to those found in Veriloid.

The effects produced by protoveratrine A, a purified crystalline alkaloid present in *Veratrum album* L. were examined in *Allium* bulbs treated with a 0.025 per cent acidified solution in fresh tap water for predetermined periods of time (3, 6, 9, or 12 hrs.). The results suggest that protoveratrine A is capable of modifying nuclear mitotic division to produce polyploid cells in roots of *Allium cepa*. The changes observed were indistinguishable from the changes reported in the Veriloid study.

125 pages. \$2.00. Mic 57-2113

HISTORY

HISTORY, GENERAL

A COMMUNITY IN TRANSITION: A STUDY OF THE IMPACT OF THE ST. LAWRENCE SEAWAY - POWER PROJECT ON MASSENA, NEW YORK, 1954-1955

(Publication No. 18,011)

Donald Ecklund Armagost, D.S.S.
Syracuse University, 1956

Any technological development of the magnitude of the St. Lawrence Seaway and Power project promises to alter the size and character of several upstate New York communities. When the Seaway Bill was passed in May, 1954,

it was recognized that Massena, New York, the American community nearest the project site, would experience the greatest impact and that problems would inevitably develop requiring local action and adjustment.

This study is an attempt to describe certain problems that arose in Massena during the first year of construction activities, from May, 1954, through the summer of 1955. It also deals with the manner in which the Village responded to the serious conditions of change and flux created by immediate expansion of population. Attention is given to the plight of a small community forced to cope with economic and political forces that, in the case of Massena, reduced local autonomy. The over-all significance of the many social, economic, and political changes that occurred within the Village are considered in the light

of their temporary and potential effect upon the character and function of Massena, a community that is being made to assume a larger role in America's industrial expansion.

In an effort to observe and evaluate what did happen in Massena during the initial stage of project development, the writer, during the summer of 1954, interviewed representatives of business, labor and civic groups; attended local organizational meetings; followed the local press; and examined pertinent primary and secondary source materials.

The study reveals that Massena was not adequately prepared to cope with the many problems that did arise in connection with the coming of the St. Lawrence project. A serious housing shortage developed, contributing to an inflationary spiral of living costs. Congestion of schools and other service facilities took place. Local merchants, with few exceptions, displayed a cautious conservatism. New business expansion was largely financed by outside corporate firms. The Village lacked the financial means to expand properly municipal facilities and sought aid from other sources, but without success. The governmental agencies responsible for construction showed little concern for Massena's community problems and apparently wanted to avoid having Massena become a "government town." Although the Village sponsored an extensive planning program, little was done in the way of implementing the plans.

The Village regarded the State Power Authority as the agency most likely to assume a responsibility for community welfare. Relations between local officials and representatives of the Authority, however, deteriorated during the first year.

Local problems relative to expansion were further compounded by the fact that Massena faced an uncertain future in respect to the question of permanent growth. As the project developed, there was considerable speculation about new industries coming into the area, but no such industrial influx occurred prior to 1956. In the meantime, the St. Lawrence project was assuring the future of the Aluminum Company of America (Alcoa), the one industry in the community that has dominated the labor market in this region for over fifty years.

The initial impact of the St. Lawrence project on Massena brought about changes within the community, reflecting characteristic stresses found in modern urban society. Massena is rapidly becoming a community in which it is increasingly more difficult for the individual and the community to adhere to traditional values that Americans have long considered basic to a democratic way of life.

265 pages. \$3.45. Mic 57-2114

HISTORY, MEDIEVAL

THE CARAVAN MERCHANTS AND THE FAIRS OF CHAMPAGNE: A STUDY IN THE TECHNIQUES OF MEDIEVAL COMMERCE

(Publication No. 21,218)

Richard David Face, Ph.D.
The University of Wisconsin, 1957

Supervisor: Professor Robert L. Reynolds

The dominant role of the fairs of Champagne in the international economy of the twelfth and thirteenth centuries has long been acknowledged by historians. Several significant studies of the internal operations of the Champagne fairs were made in the latter half of the nineteenth century, all based primarily upon sources which date from the period of the fairs' decline. But despite the monumental contributions of such scholars as Bourquelot and Huvelin to our knowledge of these great medieval institutions, the regularity of the yearly cycle of six fairs and the rigidity of the order of business followed within each, has led subsequent historians to form an oversimplified and static picture of the commercial techniques of the fair merchants. Contrary to this stereotyped view, however, the merchants who regularly attended the Champagne fairs did not arrive with their marketable goods at the opening of each fair, during the period of "entry," set up shop, and then wait patiently, their assets frozen for upwards of six weeks, while the fair labored through successive stages of cloth sale, cordovan sale, "avoir du pois," and "pagamentum."

An examination of the notarial cartularies from twelfth and thirteenth century Genoa, and a similar group of materials from Marseille, reveals quite another picture of the trade which surrounded these fairs. The pattern of operation of the so-called caravan merchants, who controlled the overland commerce between Genoa, Marseille, and Champagne during this period, is startling. In the notarial entries they can be observed arranging their business affairs in preparation for a trip to a particular Champagne fair, drawing up "cambium" or exchange contracts, preparing "accomendationes" or "societates" to do business at the fair. All this activity is normal, except that they do not allot themselves sufficient travel time so as to arrive at the fair on or near its opening date. For more than a century, in fact, our documents demonstrate that the caravan merchants never arrived at a given fair before the middle of cordovan sale, when the fair was about half over. Even more significant, they did not arrive until some time after the close of the period of cloth sale; and Flemish woolen cloth was the one commodity they were most eager to purchase. Indeed, the overland trade hung chiefly on the exchange of northern cloth and Mediterranean spices.

The nature and volume of the evidence, then, makes it clear that our description of the great medieval fairs must be revised. The merchants who regularly traded at the fairs of Champagne, or at least those who came up from the south of Europe, behaved in a fashion quite different than has hitherto been assumed. Their method of operation can be explained in terms of certain highly sophisticated techniques of business and commerce, which, taken together, render the apparently illogical pattern of the fair trade meaningful.

The caravan merchants were able to operate as they did, first, because of their extensive use of the devices of partnership, agency, and procuration. Second, the use of these techniques was strengthened and complemented by the existence of professional freighting organizations which facilitated the transportation of goods north and south. Third, rapid communication with partners or agents stationed in Champagne was made possible by a regularly scheduled courier service; and, fourth, the whole complex operation was rendered feasible by the widest possible use of credit in the trade. Moreover, this was clearly the structure of the fair trade at least by 1180; its origins are to be found perhaps a whole century earlier.

183 pages. \$2.40. Mic 57-2115

THE EARLY MEDIEVAL TRADITIONS OF EUCLID'S ELEMENTS

(Publication No. 20,236)

George David Goldat, Ph.D.
The University of Wisconsin, 1957

Supervisor: Professor Marshall Clagett

The purpose of this thesis was to edit and analyze the twelfth-century manuscript Bibliothèque Nationale Fonds latin 10257, which contains a Medieval Latin version of the Elements of Euclid replete with Graecisms.

In order to determine the proper place of this manuscript in the Medieval Latin traditions of the Elements, it became clear that the history of the traditions surrounding the Elements must be uncovered. This thesis presents both a survey of the Greek traditions (from ca. 300 B. C. to ca. 700 A. D.) and a history of the Graeco-Latin traditions (from ca. 100 B. C. to ca. 1100 A. D.) of the Elements. Further, it contains the first systematic analysis of the relations between the Graeco-Latin traditions and one of the Arabic-Latin traditions (Version II of Adelard of Bath). There is also an analysis of the B. N. 10257 manuscript in terms of the Graeco-Latin traditions and the aforementioned Arabic-Latin tradition. Finally, there is presented a collection of Latin works and fragments concerning Euclid's Elements in the Graeco-Latin traditions and there are editions of the B. N. 10257 manuscript and one manuscript of Adelard's Version II.

The results of these investigations revealed the following with respect to the Graeco-Latin traditions of the Elements: (1) that there is no present-day evidence to support the claims of some modern scholars that A. M. S. Boethius translated the full thirteen books of the Elements into Latin, (2) that there does exist a number of tracts on the geometric discipline--namely: the Ars geometriae et arithmeticae Boetii, an anonymous Geometrica ars, the Geometria Gisemundi, the Geometria Gerberti, and the Geometriae libri duo, (3) that the greatest part of the geometric knowledge attained in these traditions was contained in the tracts associated with the history of the "Corpus Agrimensorum Romanorum."

It was also revealed that the situation as regards the Medieval Latin history of the Elements changed--"per saltum"--in the twelfth century. A new phase was introduced in the history of the Elements--by the development

of the Arabic-Latin traditions. With respect to the Arabic-Latin tradition of Adelard's Version II, the results of this thesis have shown that there is little dependency of Version II upon the Graeco-Latin traditions. In considering the B. N. 10257 manuscript with respect to the Graeco-Latin traditions and the Arabic-Latin tradition of Version II, it appears that B. N. 10257 represents a syncretized tradition dependent upon both the Graeco-Latin traditions and Version II. This manuscript does not appear to represent a Medieval Latin translation from a Greek text of the Elements. In addition, this syncretization seems to be based upon an attempt to present a Latin version of the Elements which would be free from Arabic influence.

To those who are interested in the understanding of elementary geometry attained during the Medieval period, it is important that there be a history of the knowledge possessed by Medieval scholars of Euclid's Elements. In this thesis, this history was approached in at least two different yet complementary ways: (1) by examining the direct familiarity with the Elements through considering the partial and "complete" translations of the work, and (2) by uncovering the indirect acquaintance with the Elements through considering the remarks made by encyclopedists concerning geometry. In two cases--Version II of Adelard of Bath and the B. N. 10257 manuscript, it has been shown that there were texts of the Elements which could only provide a limited and distorted view of that work, since they altered and deleted the necessary order, contents, and meaning of this fundamental work. Thus, the first steps have been taken to provide the means for evaluating the state and stage reached in the history of the knowledge and understanding of Euclid's Elements in the early Medieval period. 454 pages. \$5.80. Mic 57-2116

HISTORY, MODERN

GUERRILLA WARFARE IN MISSOURI, 1861-1865

(Publication No. 14,598)

Richard Smith Brownlee II, Ph.D.
University of Missouri, 1955

The Civil War as it was fought in Missouri was largely a guerrilla war. With the exception of the two major Confederate invasions of the state in 1861 and 1864 the bulk of military operations was carried out as a result of activities by irregular pro-Southern forces. As a consequence, the face of the war in Missouri differed from that presented elsewhere in the nation. The guerrilla tactics of stealth, surprise, ambush, and total conflict took the place of frontal assault by mass armies.

The reasons for the guerrilla aspect of the war in Missouri can be found in a number of social, political, and military factors. In the first place, Missourians were predominately of Southern extraction and the institution of slavery was strong in the counties along the Missouri River and the western portion of the state. In spite of this, in the year 1860, the people were pro-Union, although there was a prominent small secessionist faction led by Governor Claiborne F. Jackson. Unfortunately, the North viewed

Missouri and her citizens as radical slaveholders and ardent secessionists because of the background of her people and the violent and illegal attempts of a few men to make the Kansas Territory a slave area in the years following 1854. The border struggles over Kansas, which included armed invasion of the territory and fraudulent elections, caused the people of the North to conceive of Missourians as secessionists.

When the war came in 1861, Governor Jackson, General Sterling Price, and a portion of the State Guard were pushed from the central portion of the state and Missouri was occupied by Union troops from Kansas, Illinois, and Iowa. These forces and their commanders tended to regard most Missourians as disloyal and the excesses of martial law and military government which followed occupation aroused numerous men to armed resistance. The swiftness of the Union strategy of occupation, which bisected the state through its center, left other actively disloyal men behind the federal battle lines. In this fashion a disloyal population was created and steadily augmented throughout the year 1861. Local guerrilla organizations arose from this population.

In addition to the above factors, the Trans-Mississippi Department of the Confederacy and General Price sent guerrilla parties into the state to recruit and to destroy federal communications. These bands were joined by the local organizations led by desperate young men such as William Quantrill, Bill Anderson, and George Todd. Effective in their mission, the guerrillas were able to hold thousands of Union troops in Missouri and in the summer of 1862 to force total mobilization of the manpower of the state.

For the most part the Union military command refused to recognize the various guerrilla organizations as legitimate belligerents. A bloody war of no quarter was begun, which saw its fiercest manifestations in the massacres at Lawrence, Kansas, and Centralia, Missouri. As the guerrilla warfare grew in intensity and frightfulness the Union command developed severer measures against the guerrillas and the population supporting them. In turn, because of their effectiveness, many officers and officials of the Trans-Mississippi Confederacy recognized and utilized the guerrillas as a valuable weapon, although frequently deploring their disregard for the laws of civilized warfare.

As a consequence, between 1861 and 1865, there was no peace in central and western Missouri. Violence, bloodshed, theft, and arson were the common features of the struggle. When the war ended whole areas of the state were depopulated, and the seeds of hatred planted during the war grew into an era of lawlessness as many of the ex-guerrillas became the notorious outlaws of the 1870's and 80's.

319 pages. \$4.10. Mic 57-2117

LOYALTY AND REPRISAL: THE LOYALISTS OF BERGEN COUNTY, NEW JERSEY AND THEIR ESTATES

(Publication No. 21,119)

Ruth M. Keeseey, Ph.D.
Columbia University, 1957

The loyalists of the American Revolution presented one of the most difficult problems of the time to government at

all levels, and every state enacted laws to curb the activities and to minimize the influence exerted by adherents of the Crown. New Jersey, which occupied a strategic position, was exposed to all the miseries of border warfare, and Bergen County, by reason of its location, was partly within the enemy's lines for nearly seven and one-half years, during which it was the site of both military actions and guerrilla activities. Traditional habits of thought among the people in this area tended to place their sympathies closer to the British Government than to the group of fellow-countrymen who demanded separation from the mother country. Loyalists here, as elsewhere, were drawn from all sections of the population, but it must be noted that Bergen County had no well-defined social classes, for the predominant Dutch culture was basically democratic in nature. Most families owned their farms and homes, others rented property on which they lived, and there were only a few notably wealthy families among the population.

Early in the war, New Jersey adopted measures intended to prevent aid being given to enemy forces while, at the same time, channeling all possible assistance to the patriots; but no ordinances were effective in keeping Bergen County inhabitants from entering the British lines. Not only were the sympathies of these people engaged on the royal side, but their pockets were filled with gold in exchange for the produce they could transport easily to the nearby market provided by British headquarters in New York. Throughout the Revolution, law enforcement in Bergen County was extraordinarily difficult, for not only did large numbers of men refuse to serve in the militia, but the loyalists could escape readily to friendly refuge in the British lines.

The New Jersey legislature sought to tighten regulations governing the population, and the comparatively mild laws of the early days of the Revolution were replaced by increasingly stringent measures, especially after the adoption of the state constitution on July 2, 1776. The most drastic step of all was taken with the law of December 11, 1778, which subjected Tories to charges of treason and provided for the confiscation of their property. Forfeiture of these holdings was to have ceased after the Treaty of Paris was ratified in 1783, but New Jersey continued to confiscate lands against which judgments had been entered prior to this time; and did not repeal acts and parts of acts "repugnant to the treaty of peace" until 1787. The state, however, found it necessary to legislate at intervals until 1830 regarding the sale of loyalist estates in attempts to clear up the situation brought about by the confiscation measures.

Though much of the state revenue during the Revolutionary period had come from these land sales, New Jersey actually profited very little because of the many legitimate claims against the estates which had to be met, and because of the great depreciation of the currency in which payments for the property were made. Since most holdings in Bergen County were less than one hundred acres, only a few large estates were confiscated there. Some tracts were divided before being sold by the Commissioners for Forfeited Estates, but most parcels were bought in one piece and added to the family possessions of the purchaser. The closely knit, homogeneous, and conservative society of this county which had evolved out of more than a century of living in the sturdy, independent, Dutch tradition appears to account, at least partly, for the

fact that no instance of intentional fraud among the Commissioners occurred here, although speculations among the agents in other counties are recorded.

The widely held belief that the confiscation and partition of loyalist estates during and after the American Revolution was primarily responsible for the democratization of land holding in the former colonies has been modified in recent years on the basis of conclusions drawn from detailed regional studies. The latter indicate that many more wealthy landholders survived the war than was believed at first, and that in some areas the democratization of landholding was due less to state confiscation than to the normal processes growing out of economic and social changes following the war. In Bergen County, landholding had been democratic from the first period of settlement in the early seventeenth century and the forfeiture of loyalist property there did not alter the traditional pattern of ownership.

323 pages. \$4.15. Mic 57-2118

THE IMPERIAL UNIVERSITY OF PEKING

(Publication No. 21,207)

Renville Clifton Lund, Ph.D.
University of Washington, 1957

The concept of the Imperial University of Peking emerged as a part of the agitation for reform and westernization which developed in Chinese official circles after the Sino-Japanese war. In 1896, in response to a memorial from Li Tuan-fen, the Throne approved the university project. Not until the Hundred Days of Reform in 1898, however, were concrete measures taken to establish the university. The university, as it emerged at this time, was an extension of the idea, previously expressed in the *T'ung-wen kuan* and the *Kuan shu-chü*, that knowledge of western techniques was a useful device for strengthening the existing dynasty and the traditions upon which it was based. As such it was able to survive the September coup which terminated abruptly most of the projects initiated during the Hundred Days. The university was finally forced to suspend operations, not by government order but by the chaos created by the anti-foreign Boxer uprising. The university was revived as a part of the new reform program of 1901 and reopened in 1903, under the direction of Chang Po-hsi. Before the university had an opportunity to demonstrate its effectiveness, the Throne ordered a reorganization of the entire system of new schools. This reorganization, largely the work of Chang Chih-tung, provided the basis upon which the university operated for the remainder of the imperial period. The university became organizationally more like western universities than it had ever been before.

The original planners of the university thought of the school as the apex of a new system of education which would eventually replace the government examinations as the means of training and defining the elite. This was finally achieved by the abolition of the government examinations. The government was convinced of the value of modern schools; to make these function effectively, it was forced to abandon a traditional institution which was a foundation stone of the existing structure of bureaucracy and of society generally. As the government relinquished

the traditional system of education, it became increasingly concerned to control the nature and content of the instruction given in the university and other schools. The western staff, which had had an important part in the early administration of the university, was dismissed in 1902. After the 1903 reorganization, the government attempted to preserve loyalty to traditional values at the university by restrictions on student activities, by enforcing Confucian ceremonies and in particular by selecting as administrators men whose devotion to traditional values and institutions had been demonstrated. However, the university, as an institution devoted to developing western skills, could not avoid introducing to the students a variety of foreign ideas. An examination of the post-university careers of the students indicates that although the university was successful in training men to use western techniques and in directing these men to government service, it failed to maintain among them complete loyalty to the old order.

363 pages. \$4.65. Mic 57-2119

JOHN WATSON FOSTER, 1836-1917

(Publication No. 19,893)

Frances Marie Phillips, Ph.D.
The University of New Mexico, 1956

Chairman: Associate Professor George Winston Smith

In his long and varied career John Watson Foster developed from an Indiana soldier, editor, and politician into a diplomat of international vision and renown. From time to time for thirty years (1873-1903), he held positions of responsibility, serving under every President from Ulysses S. Grant to Theodore Roosevelt, as Minister to Mexico, Russia, and Spain, as Secretary of State, and as Agent for the United States before international tribunals. Above the standard of the usual political appointee, he was a useful public servant, applying the vigor of his mind and his talent for organization and administration to the details of each task entrusted to him.

Foster was active in the field of international relations for almost half a century. Between appointments from his own government, he maintained a successful private practice of international law, serving as counsel to several foreign governments with a degree of ability and integrity which caused them to return to him more than once. He wrote voluminously on international relations and on diplomatic history, with the object of sharing his experiences and of developing an informed public opinion. Deeply concerned about the curse of war, he participated wholeheartedly in the arbitration movement, and in 1907 he was a member of the Chinese delegation to the Second Hague Conference. At a time when the United States was increasing in power and influence in world affairs, Foster's example and writings contributed to raising the standards and reputation of the diplomatic service at home and abroad. Although he was not identified with the inception of any startling doctrine or policy, he made a substantial contribution to the cause of international co-operation and responsibility, and left a record of efficient service.

607 pages. \$7.70. Mic 57-2120

THE SANJAK OF ALEXANDRETTA (HATAY):
A STUDY IN FRANCO-TURCO-SYRIAN RELATIONS

(Publication No. 21,356)

Avedis Krikor Sanjian, Ph.D.
University of Michigan, 1956

Following the Franco-Syrian Treaty of September 1936, Turkey demanded the independence of the Sanjak of Alexandretta, which had been governed by a 'special administrative regime' within the political unity of the French-mandated State of Syria, and guaranteed by both France and Turkey through the 'Franklin-Bouillon Agreement' of October 1921. France finally succumbed to Turkish pressures to cede the territory in July 1939. This study answers three fundamental questions: What were the bases for Turkey's claims? What motivated France's abandonment of the territory? What have been the effects on Turco-Syrian relations?

Part I examines the secret war-time Allied agreements; the 'Franklin-Bouillon Agreement' and the Treaty of Lausanne (1923); and the regulation and application by France of the Sanjak's 'special regime'--all to determine the historical position of the territory; why France agreed to a 'special regime'; the origins of Turkish irredentism and the basis for Turkey's claims in the 'Franklin-Bouillon Agreement'; and to assess France's respect for her mandatory commitments in Syria, as well as her treaty obligations towards Turkey. Part II reviews the various legal positions, the League of Nations resolutions and their unsuccessful application, the international background and implications of the dispute, and the final cession--in the light of international instruments and politics, the opposing views and the public opinion in the countries concerned. Part III discusses the effects of the territory's cession on Turco-Syrian relations from 1939 to the present.

Several general conclusions can be drawn from the study. The endowment of local autonomy to the Sanjak in 1918 ensured the rising Kemalist movement of French concern for the Alexandrettan Turks. The 'Franklin-Bouillon Agreement,' which made Turkey a guarantor of this autonomous regime, proved a spring-board for Turkish intervention and penetration. The Treaty of Lausanne did not recognize the Sanjak's autonomy, but its confirmation of the Turco-Syrian boundary fixed by the 'Franklin-Bouillon Agreement' left the territory within French-mandated Syria. Although seemingly acquiescing in the status quo, Turkey had made no secret of her determination to recover the territory. France's continued appeasements of Turkey in disregard of her mandatory obligations for Syria's integrity, sparked further Turkish claims, culminating in demands for the Sanjak's independence in 1936.

Turkey's favored diplomatic and strategic position as the sole guardian of the Straits, and Italy's threats in the eastern Mediterranean, determined the course and ultimate disposition of the Sanjak crisis. French political and military expediency placed containment of the Axis and security of the Dardanelles before her mandatory obligations. This basic conflict in French obligations was carefully exploited by Turkey at the expense of Syria and the territory's non-Turkish majority. The League itself succumbed to every expediency until the final settlement in which it had no say.

Juridically, the cession violated the Charter of the Mandate, the 'Franklin-Bouillon Agreement,' the Treaty of

Lausanne, the League's decisions, and several Franco-Turkish agreements. Politically, it revealed a definite basis in a strong power rivalry. From the 1921 evacuation of Cilicia and the concession of an autonomous regime for Alexandretta--both directed against Anglo-Greek influence in the Aegean and Anatolia--to the later anti-Axis developments; Alexandretta proved the convenient pawn to balance the bigger account of Franco-Turkish friendship and co-operation.

The bitter effects on Turco-Syrian relations persist. It is doubtful that Syria would raise the issue internationally, but the question will probably have periodic revival resulting from any Turco-Syrian disagreements affecting their mutual relations--internationally or locally. For all practical purposes, however, despite their refusal to recognize this *ultra vires* cession, Syrians seem resigned to the *fait accompli*. 320 pages. \$4.10. Mic 57-2121

THE PROGRESSIVES AND AMERICAN FOREIGN
POLICY, 1898-1917: AN ANALYSIS OF THE
ATTITUDES OF THE LEADERS OF THE
PROGRESSIVE MOVEMENT TOWARD
EXTERNAL AFFAIRS
(VOLUMES I AND II)

(Publication No. 21,456)

Robert Seager II, Ph.D.
The Ohio State University, 1956

The foreign policy views of some one hundred seventy-five prominent leaders of the progressive movement, men whose public lives attracted national attention, were analyzed to ascertain the existence or nonexistence of any pattern of attitude toward American diplomacy among reform-minded Americans who made significant contributions to the crusade for domestic reform during the years 1898 to 1917.

The materials consulted included the available memoirs, published letters, books, articles, pamphlets, and speeches of progressive leaders in various fields. Special attention was given the statements and activities of progressives elected to Congress. Existing biographical studies and the scholarly monographs treating the political, economic, and diplomatic controversies of the period were also utilized.

The primary conclusion reached was that the reform idealism of domestic progressivism was complemented by and manifested in progressive dedication to a diplomacy characterized by idealism and expansionism. While this commitment was tempered by, often subordinate to, the practical realities of partisan politics, most progressives generally endorsed the paternalistic and humanitarian idea that it was America's manifest destiny to uplift and reform, indeed Americanize, "backward peoples." Progressive attitudes toward Cuba, Philippine annexation, Roosevelt's "Big Stick" in Latin America, and Wilson's "missionary" diplomacy in Mexico and the Caribbean suggest this interpretation. Further, most progressives viewed foreign policy from a distinctly moralistic, capitalistic, and legalistic standpoint. Believing that American diplomacy should uphold democracy, private property, and the rule of law throughout the world, they initiated and supported policies designed to humble foreign leaders and

governments hostile to these principles. Their opposition to Weyler's activities in Cuba, Huerta's behavior in Mexico, and the Kaiser's pretensions in Europe and on the high seas was vigorous.

Eschewing pacifism, most progressives also believed that the ultimate foundation of a diplomacy of righteousness was military compulsion, and that peace itself could best be attained and maintained by the employment of force. Consequently, they endorsed naval expansion, military preparedness, and the idea of an international league to enforce peace. They supported armed interventions in the Caribbean, and they marched eagerly to war in 1898 and 1917.

In the field of economic foreign policy, most progressive leaders favored activities designed to expand American trade abroad. Deriving as they did from the comfortable middle class in America, they felt that only an expanding capitalist economy could forestall the growth of a domestic radicalism nurtured on the economic stagnation implicit in unconsumed surpluses. Thus they upheld or acquiesced in such commercial expansion ideas as the Open Door, Dollar Diplomacy, lower tariffs, reciprocity treaties, merchant marine expansion, and maritime neutral rights.

Not all progressive leaders endorsed these general goals in American foreign policy. A bipartisan minority group vigorously dissented. Led by Robert M. La Follette and William Jennings Bryan, this little band of Middle Westerners espoused a variety of anti-expansionist, pacifist, economic isolationist, and Anglophobe sentiments decidedly unpopular with most progressives. The political upheaval of 1912, however, sharply reduced the importance of both Bryan and La Follette in progressive leadership circles. Post-1914 opposition to differential neutrality, military preparedness, and a league to enforce peace suggested pro-German sympathies and further separated the Bryan-La Follette faction from the main stream of progressive foreign policy thought. By January, 1917, they were ideologically isolated and politically impotent.

Actually, most progressives followed the leadership of Wilson and Roosevelt and championed a diplomacy geared to the humanitarian conviction that America should aggressively uphold righteousness and morality throughout the world. While the Wilson progressives and Roosevelt progressives differed on some fundamental issues, like American participation in a league to enforce peace, they had more in common ideologically than either had with the Bryan-La Follette minority.

446 pages. \$5.70. Mic 57-2122

AMERICAN CONTRIBUTIONS TO PHILIPPINE SCIENCE AND TECHNOLOGY, 1898-1916

(Publication No. 21,233)

Joseph Benjamin Van Hise, Ph.D.
The University of Wisconsin, 1957

Supervisor: Professor Merle Curti

Can American scientific knowledge and technical skills be used by Americans to promote the health and welfare of materially disadvantaged peoples overseas?

The first Americans in the Philippines, the United States Volunteers, used American skills to defeat the Spaniards and suppress the Philippine Insurrection. They repaired a railroad, for example, spun telecommunication wires, sanitized Manila, and opened Quartermaster workshops.

Exercising plenary powers, the United States Philippine Commission brought over American technical experts to improve public health, aid agriculture, conserve and exploit Insular sylvan, mineral and piscian resources, and construct public works.

Applying germicides and quarantine, American sanitary inspectors fought cholera and terrorized an uncomprehending and uncooperative native population. Lepers were segregated. Filipinos were vaccinated. The American Director of Health, who had persistently used reliable American health officers rather than "inept" Filipinos, was replaced as soon as Filipinos obtained home rule, his draconian procedures having alienated the public, the politicos and the local medical profession.

Experts from Washington advocated the mechanization of the rice paddies, the sowing of American seed (particularly corn), and the irrigation of Luzon's lowlands. In each case a technique, successfully proven in America, failed in the Philippines. Veterinarians were unable to halt an epizootic of rinderpest through prophylactic inoculation or by constabulary quarantine.

American foresters tried to conserve Insular hardwoods against the ravages of American lumber companies and native caingin makers, without notable success.

American engineers jerrybuilt narrowgauge railroads into unprofitable hinterlands. Their admirable network of all-weather roads, crossing permanent bridges of reinforced concrete, gave way ultimately under the pounding of motor trucks. They built major harbor works at Manila, Iloilo, and Cebu, but did not improve the lesser outports, nor successfully modernize the inter-island merchant marine. Manila acquired a modern sewer system and water supply, a city plan, and imperial edifices of Classic mode.

A cadre of scientists-in-residence at the Philippine Bureau of Science served the other bureaus and offered scientific solutions to Insular economic problems. They could not compel industrial advances when American investors and Philippine capitalists were wary or disinterested.

American colonial administrators failed to apply American science and technology with greater success because: (1) Technical answers, worked out in America, did not necessarily resolve roughly similar Philippine problems; while American experts in the Islands, baffled by the novel, only sometimes improvised successfully. (2) A hydra-headed Commission form of government made coordinated planning and efficient administration of technical services difficult. (3) The United States Government was unwilling to invest money in Philippine development, and all technical projects had therefore to be paid for from limited Insular revenues; while Congressional restrictive land policies discouraged private American investment in mining and plantation agriculture. (4) The grant of increasing measures of autonomy to Filipinos gave their national spokesmen a veto over unpopular projects, and assured a filipinized civil service largely purged of expensive American experts. (5) American administrators, who assumed that only American specialists knew the

answers, preferred not to use Filipino scientific or technical personnel; while at the salaries the Philippine Government would offer, competent American specialists often could not be hired for, nor retained in, the Insular Service. (6) The Proconsular rulers assumed that the American regime would last for a generation or more, and they made no systematic provision, therefore, for the orderly and timely transfer of Philippine technical services to well-trained and experienced Filipinos.

Although the particular projects they sponsored frequently miscarried, Americans taught Filipinos to expect technical advice and help from their government. Because of American colonial rule, Filipinos became the more quickly aware of the potential usefulness of Western science and technology, and the more prone to try Western ways.

629 pages. \$8.00. Mic 57-2123 .

**THE UNITED STATES WEATHER BUREAU:
ITS SCIENTIFIC DEVELOPMENT AND
PUBLIC SERVICES, 1870-1941**

(Publication No. 20,894)

Donald Robert Whitnah, Ph.D.
University of Illinois, 1957

The development of meteorology in the United States during the past hundred years is traced through a description of our national weather service. Significant advancement in both the use of meteorological instruments and the general knowledge of weather theory had been made prior to the middle of the nineteenth century. Progress in scientific forecasting of future weather phenomena, however, could not be initiated until rapid means of communications were available in order to provide current observations from a wide geographical area. Invention of the telegraph provided the means, resulting in widespread efforts to forecast weather. These included privately-sponsored enterprises of the type organized by Cleveland Abbe in Cincinnati and I. A. Lapham in Chicago and Milwaukee. Their success persuaded Congress of the possibilities of a national service supported by the government. The result was the establishment in 1870 of meteorological services for the nation under the Army Signal Service.

Military officials employed Abbe, Lapham, and other civilian meteorologists to establish a network of observa-

tional stations, inaugurate a system of daily forecasts, collect additional data for climatological purposes, train military forecasters, and launch a variety of special services which included river and flood forecasting, research on tornadoes, and the exchange of information on an international basis.

Scandal, personal intrigue, and general strife within the Signal Service prevented the most effective functioning of this purely scientific organization. For this reason Congress transferred, effective in 1891, the service to the Department of Agriculture. It was henceforth known as the Weather Bureau. Unfortunately, internal dissension did not immediately disappear. Personal and political differences between the Secretary of Agriculture and the Chief of the Weather Bureau resulted in the removal of the latter.

There was a period of marked development during 1895-1913. Scientific activities involved kite and pilot-balloon observations of the upper air, climatological studies, aid to the Wright brothers, and other early aviators. The new fields of evaporation, seismology, and solar radiation were also explored. Recording instruments were now employed on a wide scale. General services, especially the distribution of forecasts, were improved. Drastic attempts by Chief Willis Moore to become Secretary of Agriculture led to his removal from office by President Woodrow Wilson.

The Bureau now embarked on a period of internal stability under the successive leadership of C. F. Marvin, Willis R. Gregg, and F. W. Reichelderfer, who remains as chief today. There was a modernization of established services with the addition of such new activities as fire-weather forecasting, four daily forecasts instead of two, the five-day forecast, and renewed interest in agricultural meteorology.

An innovation causing vast expansion of Bureau functions was the inauguration in 1926 of systematic aid to aviation. Airport stations now offered twenty-four-hour service. Notable services were also given to the early transatlantic fliers, including Charles Lindbergh. The interest in aviation led to scientific advancement in observational techniques. The radiosonde, successor to previous efforts with kites and airplanes, was perfected to give automatic transmission of weather data from the upper air. Two-way radio and the teletype revolutionized communications. Aid to aviation led to the transfer of the Bureau in 1940 to the Department of Commerce, which already controlled other forms of federal aid to aviation.

312 pages. \$4.00. Mic 57-2124

HOME ECONOMICS

INSTITUTIONAL HOUSING AS A FACTOR IN THE BEHAVIOR OF OLDER PEOPLE

(Publication No. 20,414)

Mary Elizabeth Kesler, Ph.D.
Cornell University, 1956

The Problem and Major Hypotheses

Today the proportion in the population of sixty-five years of age is rapidly increasing, and its effect is being felt in many aspects of our political, social and economic life. The present study was concerned with one small phase of the problem, namely, institutional housing for older people. Its purpose was to determine how the lives of older people change as a result of moving into homes for older people. The following major hypotheses were tested:

- (1) That important changes occur in the daily activities of older people when they move into an institutional type of home.
- (2) That decrease in the health status of the individual will create an unfavorable attitude toward the home.
- (3) That the health of an individual will affect his activities and satisfaction with the home.
- (4) That the size of the home will affect one's activities and attitude toward the home.
- (5) That the better the adjustment to the home, the greater will be the personal adjustment to the individual.
- (6) That physical structure of the home will affect the formation of friendships among members.

The Sample

Three homes in Minnesota were selected according to three criteria; namely, (1) the homes should be non-profit and Protestant; (2) they should vary in size; and (3) the background of the respondents should be more or less comparable in the various homes as to age, sex, educational background, etc.

The total population interviewed was 104 including 80 residents at Largent, 17 at Middleton, and seven at Littleton. Thirty-five other occupants of the homes were not included in the sample for a variety of reasons, primarily of a health nature. Names used for the homes are fictitious and are indicative in each case of the size of the home.

The Schedule

A schedule of questions covering three areas: (1) Home Adaptation, (2) Attitudes and Activities, and (3) Sociability and Acceptance was developed, pretested, and revised before used.

Research Analysis

Research Analyses included (1) Guttman scale technique as applied to attitude toward the home and personal adjustment of the residents, (2) Chapin's Participation scale, and (3) sociometric techniques to measure choice-making. Weighted index scores were used for activities and for two measurements of health.

The Three Homes

Largent has a bed capacity of 100 and a 30-bed infirmary which admits both men and women at age 70. To be admitted, a personal interview is required, and an admission fee of \$2,000 is paid if the applicant becomes a resident for the year of required probation. Private rooms are available for all who desire them. The home is located on a lake in the residential area of Minneapolis.

Middleton has a bed capacity of 25. Men and women are admitted at age 65. Financial arrangements are made according to the circumstances of the individual case. The home is located at the edge of the town of Winnebago (Minnesota).

Littleton has a bed capacity of 14. All rooms are shared except in one instance. All guests are over 65. The home is located in the village of Kasota (Minnesota).

Characteristics of the Residents

A study of the characteristics of the residents and their background before moving into the homes showed that: (1) two-thirds of the population in the homes were 80-97 years of age, the median age being 82.5 years; (2) their educational level of attainment was equally divided between completion of the eighth grade or less, high school, and college; (3) the ratio of men to women was one to seven; (4) two-thirds of the home members had lived in their last place of residence a relatively short period of time; (5) 49 per cent had lived in their own household previous to entering the home; and (6) of the latter group, only 28 per cent had owned their property.

Major Findings

Major conclusions drawn from the analyzed data were:

(1) Two-thirds of the men and one-half of the women classified their own health as good, with residents tending to minimize their illness or affliction. Health was found to be closely related to residents' activities, personal adjustment, and attitude toward the home.

(2) All residents at Littleton indicated they ate and enjoyed meals more now than they had before they entered the home, while 45 per cent at Middleton enjoyed them less. Little change was noted at Largent. In all cases, however, these residents were favorable in their attitude toward the home.

(3) Almost one-half of the residents said that they got dressed for the day earlier than they had before entering

the home, and none said later. They were also more conscious of their appearance, particularly at Largent.

(4) The majority of residents reported 70 per cent more "spare time" than they had before entering the home. One-fourth reported spare time on their hands. A program of useful work, gardening, making of handicraft articles, writing, reading, listening to the radio, and playing games occupied a part of this spare time. In general, it can be said reading declined, active participation as measured by Chapin's participation scale decreased, while the playing of games increased, particularly at Largent.

(5) Residents' responses to satisfaction with their present home as contrasted with their last living arrangements, showed a 30 per cent gain in the number of persons satisfied. There was a gain of 27 per cent in the number satisfied with their location. Over half of the people were much happier than or just as happy as before. Ninety-one per cent of the residents approved of the plan of room assignments. The sociometric study, however, did reveal the importance of room location to social interaction. Occupants of end rooms and those residing in corridors with closed structural design were found to have low sociometric scores. Members living near communal bathrooms and entrances to sunrooms had high social acceptance scores.

(6) In general it can be concluded that the large home offered many more advantages than the smaller ones. It offered a greater variety of activities, a greater opportunity for a wide selection of friends, and a constant availability of persons with whom one could play games. Location in a large community where there was adequate public transportation fostered a feeling of independence in the residents and made shopping and recreation available at some distance from the home.

215 pages. \$2.80. Mic 57-2125

DECISION-MAKING IN RELATION TO MANAGEMENT IN CLASSES OF HOME ECONOMICS BY BEGINNING TEACHERS

(Publication No. 20,082)

Beatrice Paolucci, Ed.D.
Michigan State University, 1956

Chairman: Mary Lee Hurt

This investigation was undertaken in order to study decision-making relative to management in classes of home economics by beginning teachers. A selected group of twenty-four beginning teachers was used. Each teacher recorded the decisions she made relative to classroom management for an intermittent, specified two week period. A focused interview was conducted with each teacher in order to probe more deeply into the decisions she recorded.

This study was based on the following hypotheses:

1. The number and kinds of decisions related to management in classes of home economics will vary among beginning teachers.
2. Decision-making in relation to management in classes of home economics is related to factors of: (1) length of time needed to arrive at closure; (2) ease with which closure is reached; (3) autonomy;

(4) knowledge and information available for arriving at a decision; and (5) the expectations of the managerial role of the teacher of home economics held by the beginning teacher.

3. The satisfaction resulting from decisions made in relation to management in classes of home economics will vary among the beginning teachers.

The findings of this study in relation to the above hypotheses were:

1. Beginning teachers varied in the number of decisions they made and recorded relative to management in classes of home economics. The number varied from thirty-one to three decisions. The number of alternatives considered for each decision varied from two to seven.
2. Beginning teachers tended to be alike relative to the kinds of management decisions they made. Decision-making was identified in situations related to "how to teach," "care and use of room, materials, and equipment," "use of time," "money," "interruptions," "discipline," and "what to teach."
3. Length of time required for decision-making was related to the kind of decision being made and was determined by personal and situational factors.
4. Ease in decision-making was related to amount of knowledge, skill, or information available, relative certainty of consequences, limitation of number of alternatives, and past experience in a similar decision-making situation.
5. Autonomy was related to the persons with whom it was possible for the teacher to share decision-making, the importance of the outcomes of the decisions, and the sources of help available to the teacher for decision-making.
6. Beginning teachers tended to rely upon past experience as the chief source of help in decision-making.
7. Expectations of the managerial role of the home economics teacher held by beginning teachers seemed related to decision-making.
8. Beginning teachers were generally satisfied with their decision-making relative to management in classes.
9. Recognition, approval, achievement, conformity, efficiency and success were identified as factors which contributed to satisfaction in decision-making. Disapproval, inefficiency, inequality, lack of achievement, lack of success and uncertainty were identified as factors contributing to dissatisfaction in decision-making.

The findings of this study partially support the hypothesis that beginning teachers would vary in the number of decisions they made relative to management in classes of home economics; they refute the hypothesis that they would vary in the kinds of decisions they made. The hypothesis that factors of length of time, ease, autonomy, knowledge and information, and expectation of the managerial role were related to decision-making was supported by the findings of this study. The hypothesis that beginning teachers would vary in satisfactions derived from decision-making was partially refuted by the investigation, beginning

teachers tended to be more alike than different in their satisfactions relative to management decisions.

203 pages. \$2.65. Mic 57-2126

STUDIES OF CERTAIN FACTORS AFFECTING METHIONINE REQUIREMENT

(Publication No. 20,263)

Dorothy Lorraine Steel, Ph.D.
The University of Wisconsin, 1957

Supervisors: Professors May S. Reynolds
and Carl A. Baumann

The methionine requirement of women 23 to 32 years old was studied with nitrogen balance as the criterion of adequacy. Methionine levels of 0.26 gm and 0.47 gm in the presence of 0.29 gm to 0.47 gm of cystine were adequate for 9 of 10 subjects, given a semi-synthetic diet in which wheat flour furnished part of the essential amino acids.

In a subsequent study with a nearly synthetic diet, a daily intake of 0.29 gm of methionine and 0.26 gm of cys-

tine permitted the establishment of nitrogen equilibrium in young women 19 to 26 years old. Levels of 0.29 gm of methionine and 0.01 gm of cystine were inadequate for the maintenance of nitrogen equilibrium for 3 of 5 subjects. With the addition of 0.125 gm of cystine, nitrogen balance was restored in 2 of these subjects. When 2 subjects were given 0.19 gm of methionine and 0.089 gm of cystine, nitrogen equilibrium was maintained in only 1 subject. In both studies an increase in caloric intake was necessary for the maintenance of body weight when the subjects were changed from the natural foods of the normal diet to the highly purified experimental diet.

Measurements were also made of the amounts of methionine required by the adult male rat for the maintenance of nitrogen balance at various levels of caloric intake. Within the range of 3.0 to 4.2 mg of methionine, the methionine requirement seemed to vary inversely with the caloric intake.

Analyses for cystine in the foods used in the low-protein diets were most successful when a relatively high dilution was used during the hydrolysis procedure and when the salt concentration in the hydrolysates was reduced by the partial removal in vacuo of the hydrochloric acid prior to neutralization.

181 pages. \$2.40. Mic 57-2127

LANGUAGE AND LITERATURE

LANGUAGE AND LITERATURE, GENERAL

BOSSUET ON POLITICS, HISTORY AND JANSENISM

(Publication No. 21,163)

Constantine George Christofides, Ph.D.
University of Michigan, 1956

This study is a pioneer attempt to formulate and examine Bossuet's political philosophy and to interpret his historical work as a philosophy of history. Further, this study reconciles previous differences of opinion and corrects numerous errors concerning the relation of Bossuet and Jansenism.

In the first part of the dissertation Bossuet's ideas on power, divine right and the relationship between church and state are presented. The derivation of a theory of power from Bossuet's work is a complicated task inasmuch as he is not clear or consistent in his fundamental principles about society, government and law. A careful examination of all his pronouncements on power results in the formulation of an absolute theory that disregards natural law and is concerned more with the idea of who holds power rather than the question of the duties of power. A more valid theory is Bossuet's recognition of the society of a nation as a given fact of historical evolution, not created by a contract (unlike the state based on a society, which may come into existence as a result of a creative act performed by the members of the society).

Bossuet is the most extreme exponent of the theory of the divine right of kings: the idea that the ruler, however

wicked he may be, is accountable only to God for the way he exercises power.

By asserting the omnipotence of the rights of the sovereign and the separation of the powers of church and state Bossuet indicates the new domination of the state in modern politics. The Bishop himself followed this affirmation during the Gallican controversy of 1681-1682.

The second part of this dissertation is concerned with Bossuet's philosophy of history: a systematic interpretation of universal history in terms of a pattern--Providence--which explains why events followed the course that they did and which thereby offers the clue to the ultimate significance of those events. Bossuet with one glance wished to embrace the whole of human destiny: its origin, its end. What he did not realize is that history written from this point of view, unless it is divine revelation (which he did not claim to have), does not yield meaning in such rigid terms. In order for history to become "vision", knowledge must come to it outside of history, as when God speaks through the mouth of prophets, or when the totality of future human destiny is discovered in the depths of the past.

An examination of Bossuet's stand on Biblical exegesis, a by-product of seventeenth-century scientific spirit, shows the Bishop an implacable enemy of criticism of the sacred texts. However, during his life, Bossuet showed extreme concern for primary sources, both Biblical and secular. The true text of the Bible, according to Bossuet, was definitively fixed by the citations and interpretations of the Church Fathers and proposed amendments to what the Church had maintained for centuries would lead to disastrous results by confusing the flock of believers.

Lastly, this study considers the theory that Bossuet was pro-Jansenist, a theory persisting among the Bishop's biographers: Brunetiere, Rébelliau, Lanson, Urbain, etc. Their evidence, largely speculative and inconclusive, is systematically refuted with counter-evidence based exclusively on Bossuet's work and correspondence.

Two general conclusions may be drawn from this study: 1) Bossuet's political theory, founded on Biblical divine injunctions rather than natural law, is significant because it recognizes the importance of the modern secular state whose powers are divorced from those of ecclesiastical authority. 2) Bossuet remained consistent in his writings, basing his whole system of thought first on the Bible and second on the Church Fathers. He defied Rome when the power of the state--Louis XIV--was challenged by the Pope, but always upheld the authority of the Roman Catholic Church in doctrinal questions, against both Biblical critics and Jansenists, against even Saint Augustine.

200 pages. \$2.60. Mic 57-2128

THE SEVEN DEADLY SINS IN PARADISE LOST

(Publication No. 20,577)

Robert Charles Fox, Ph.D.
Columbia University, 1957

In Paradise Lost Milton made extensive use of the system of the seven deadly sins which was first set forth by Gregory the Great in his Moralia in Job (ca. 590) and, with slight modifications, was embodied in a great number and variety of works during the next thousand years. The essential features of this system are as follows. The soul, once captivated by pride, progresses through the states of envy, wrath, sloth, avarice, gluttony and lust. The first five of these sins are spiritual, in contrast to the last two which, since they render pleasures to the body, are carnal. All particular sins arise from one or the other of these seven root-principles of evil in man.

Milton used this Gregorian system for two important functions in Paradise Lost: (1) to serve as a means of selecting and characterizing his major diabolical and personified figures; and (2) to give a theme and a structure to the vision of history that Michael reveals to Adam.

Satan embodies pride and envy, the first two of the deadly sins. Satan falls primarily through pride, with his envy of the Son providing the immediate occasion. After his fall, he continues to manifest his pride, and ultimately he directs his envy towards man in the state of innocence and happiness. Beelzebub is also a symbol of envy, a representative of one side of Satan's many-sided character. Beelzebub becomes infected with Satan's envy on the night of the rebellion; later, in the council, it is Beelzebub who persuades the assembled legions to approve a policy based on envy of man.

In the infernal council, the next three deadly sins are symbolized by the three debaters: wrath by Moloc, sloth by Belial, and avarice by Mammon. Hence the five spiritual sins are represented by the five principal devils, with each devil appearing according to the order of his respective vice in the Gregorian sequence.

The two carnal sins are represented by Sin and Death, both of whom function as double personifications: Sin per-

sonifies sin in general and sexual sin in particular; Death personifies death and gluttony. The allegorical accounts of the birth of Sin, of her incest with Satan, and of the subsequent union of Sin and Death--these convey various concepts about the nature of the carnal sins, their connection with each other, and their relationship with the spiritual sin of pride.

In Michael's revelations to Adam the seven deadly sins again appear, this time on the human level and, with one exception, exemplified by figures taken from the early chapters of Genesis. Michael's pageant opens with a vision of Cain murdering Abel, a murder motivated by envy. The next scene, the Cave of Death, is a non-historical and allegorical depiction of those who have fallen victims to gluttony. The third scene portrays two deadly sins: avarice by the sons of Cain and lust by their daughters, the bevy of fair women, who seduce the Sethites. The giants in the fourth scene are figures of wrath. In the fifth, the age of Noah is characterized by sloth and by several other sins closely associated with sloth. After presenting these five visions directly to the eyes of Adam, Michael then relates the remainder of his material in the form of a narrative. He tells of the deeds of Nimrod and his followers who are types of pride. With the seven sins thus depicted in human forms, Michael turns to the Biblical figures--from Abraham to Christ--who illustrate man's gradual redemption from evil. 225 pages. \$2.95. Mic 57-2129

CHARACTER FOILS IN SHAKESPEARE'S COMEDIES AND HISTORIES

(Publication No. 20,958)

Lloyd A. Hanawalt, Ph.D.
The Pennsylvania State University, 1957

The problem of the dissertation is to determine the extent of Shakespeare's practice of having characters set one another off dramatically by contrast: the degree to which the individual characters are effective as figures of character-contrast, the identity of the outstanding character foils, the dramatic conditions of scene, plot, action, and personality that are most conducive to characterization by contrast, the relation between the dramatic excellence of each play and its effectiveness as a medium of character foils, the extent to which the sources and the date of composition affect his use of foils.

The comedies and histories were exhaustively analyzed for all instances wherein characters illuminated one another dramatically by contrast. In every case a strong figure was observed surrounded by a group of satellite characters that in turn throw light on phases of the major figure. The total of these contrastive illuminations by minor foils reveals the major character in his full lifelikeness and dramatic force. Sometimes, however, major figures are mutually revealing by contrast throughout most or all of the play. Minor characters are then less important. Lesser characters, moreover, are mutually revealing by contrast; for each figure is set off contrastively to the degree that he has kinetic dramatic force. These cases in which each figure appeared as one of a pair or group in contrast were counted and the relative importance of the characters and plays was determined by their total points of contrast.

The histories were found stronger in super figures of character-contrast and in far-reaching cases of character reference by contrast. Richard III and Henry V are supreme as character foils because their figures absorb all others in their respective dramas. The extended contrast between Richard II and Bolingbroke is Shakespeare's supreme achievement in contrasting a character pair; two major characters, representing two worlds, are contrasted through five acts given over almost wholly to their depiction. Falstaff is by far the greatest figure as a super hub of a multitude of character foils and I-II Henry IV is the greatest repository of related foils because Falstaff is virtually an epic figure in an epic drama. Women hold their own as important character foils, though they are far more important in the comedies where romantic love and domestic conflicts abound. A contrast figure is high in rank as a foil to the extent that he is variable in temperament--but leaning to the serious side--, forceful in personality, persistent and intense in emotion, constant in action, and meaningful to the theme. A character group has contrastive force chiefly to the extent that its members are definitely and variably singularized. A play will be replete with contrastive characterization to the extent that it has vital complex characters, contrastive atmosphere, multiplicity of plot, continuous action, and symbolic meaning. Twelfth Night best meets these requirements. The characters presented and the type of dramatic material are more important than the date of composition in determining use of character foils. The sources do not offer many cases of character foils as Shakespeare uses them. In any case the important qualities for good character foils are variety, activity, persistence, intensity, and unrestrained expressiveness. 483 pages. \$6.15. Mic 57-2130

A CRITICAL EDITION OF MEDITATIONS ON
THE PASSION, MICHIGAN STATE COLLEGE
MANUSCRIPT NO. 1

(Publication No. 21,066)

Joseph B. Jenks, Ph.D.
Michigan State University, 1956

The purpose of this dissertation was to prepare a critical edition of the first manuscript acquisition of Michigan State University. The initial problem was to decipher the handwriting of the scribe and to expand his abbreviations. When this was done, a textual edition was prepared.

The next problem was to determine whether this English manuscript was an original work or a translation. The fly-leaf indicated that the author was Wycliff, but internal evidence disproved this. Many other works on the same subject were ascribed to St. Bonaventure and a search of the two different Latin editions of his Opera Omnia revealed that the MS was an English translation of a Latin work sometimes attributed to him.

To determine the authenticity of St. Bonaventure as the author of the original Latin required a visit to the Franciscan Institute at St. Bonaventure University in New York. At the Institute it was necessary to read articles on the authorship problem by a number of Franciscans over the last forty years.

It was important to determine whether the MS was

unique or if there were related MSS. There were discovered a number of related MSS, but only three closely related. There was also discovered one fairly closely related printed edition, that of Nicholas Love. In transcribing these three closely related MSS, Bodley 789, Caius 646/669 and Laud Misc. 23, in order to collate them with the Michigan State manuscript, the problems of deciphering and abbreviation expansion had to be solved for each MS as in the first instance.

In preparing the finished text, it was decided to transcribe in parallel, with the Michigan State manuscript, the Latin original, and the Bodley MS (with variants in Caius and Laud noted) appearing on opposing pages. To do this required the establishment of a close coincidence among all three versions on each page, and decisions regarding the identification of prose and verse in the Michigan State MS.

A side issue of the problem which was not solved was that of the identification of the MS water-mark. This involved the examination of thousands of water-marks in the collections of the following libraries: Michigan State University, University of Michigan, the Franciscan Institute, Columbia University, New York University, the New York Public and the Library of Congress. Despite exhaustive search, the origin of the water-mark has not been traced.

The MS was dated as middle fifteenth century by reference to the three collated MSS whose dates are known, and by linguistic and paleographic evidence. The dialect, Northeast Midland, of the MS was determined by linguistic evidence.

Since the history of the MS is sketchy, the determination of the literary value of the MS was approached from a study of the popularity of the Latin original and the vernacular translations. The study (based on the number of MSS and translation) revealed that this version of the Pas- sion by St. Bonaventure was the most popular account of the life of Christ in the Middle Ages. The most popular English version (based on the number of MSS and printed editions) was the authorized translation of Nicholas Love. It was attempted to demonstrate by direct comparison of parallel parts that the translation of the MS was superior to that of the Love translation.

It was concluded that the translator of the Michigan State MS wrote in the poetic tradition of the alliterative revival, and that his work bears favorable comparison with the works of the major English writers of the Middle Ages. 299 pages. \$3.85. Mic 57-2131

CLASSICAL MYTH IN CHAUCER'S TROILUS AND
CRISEYDE: AN ASPECT OF THE CLASSICAL
TRADITION IN THE MIDDLE AGES

(Publication No. 20,134)

John P. McCall, Ph.D.
Princeton University, 1955

The primary aim of this study has been to elucidate the classical allusions in Troilus and Criseyde, the poem in which Chaucer used the greatest amount and variety of mythological material. In the first Chapter a general examination of the classical tradition has been made, and particular emphasis has been placed upon the development

of the interpretation of mythology from the early Middle Ages to 1400. The relationships between the commentaries on Virgil, Statius, Ovid, Martianus Capella, and the mythological handbooks from Fulgentius to Colucci Salutati, have been observed. In all this there is a recognizable continuity. The early euhemeristic, naturalistic, and ethical interpretations of the gods, which appeared in pagan writings, were gradually elaborated until, by the twelfth century, specifically Christian moral interpretations of pagan fables began to appear. At the same time there was a suggestion that anagogical, or specifically other-worldly, interpretations of the gods and their fables were becoming popular. By the time of Chaucer pagan mythology was extremely rich in its figurative connotations.

In view of the tradition which has been examined, the remainder of this study is devoted to an elucidation of Chaucer's text. The second Chapter deals with the classical-medieval view of hell and with its mythological inhabitants as they appear in *Troilus and Criseyde*. First the traditional meanings for each allusion, eg. the Furies, Tityus, Cerberus, etc., have been examined, and in each instance the context of the allusion, and other pertinent passages in the poem, have been brought to bear in order to show how Chaucer used and adapted the traditional mythological meanings. In the third Chapter the same method is applied to the major classical deities, Jupiter, Mars, Venus, Cupid, Diana, and Apollo. All of these figures have one thing in common: they are ambiguous. With the first four deities an attempt has been made to understand these ambiguities and to realize their potentialities as metaphors in a literary context. The last two deities, although capable of the same kind of consideration, have been examined primarily as astronomical bodies.

A number of classical allusions which require little more than a medieval understanding of their literal significance have been treated in Chapter four. Pallas is discussed chiefly in terms of the character of Criseyde, and Juno in terms of the liaison between the lovers. Mythological birds appear in a way that reflects upon the movement of the poetic action. A final miscellaneous section deals with unique allusions to Niobe, Janus, Amphiaraus, Oedipus, Mirra, and Argus. The fifth Chapter is an expository resumé in which the allusions are considered in terms of their continuity, their interrelationship, and their use in the poem as a whole; a few minor allusions have been examined in the process. The final Chapter is devoted to the Trojan background of *Troilus and Criseyde*. A particular study has been made of the significance of the fall of Troy in the light of the medieval conception of tragedy, and this in turn, has been related to the development of Chaucer's tragedy.

An attempt has been made throughout to show that Chaucer made subtle, unassuming, realistic, and yet meaningful use of classical material. His learned allusions reinforce ideas and themes which he has elsewhere stated in less oblique fashion. In fact, his allusions generally become clear in their immediate context so that even where he appears to be most obscure, he maintains an awareness of form and meaning completely in accord with the unity of his poem.

375 pages. \$4.80. Mic 57-2132

LANGUAGE AND LITERATURE, CLASSICAL

THE ENTHYMEME IN ARISTOTLE

(Publication No. 20,118)

William M. Anthony Grimaldi, S.J., Ph.D.
Princeton University, 1955

The enthymeme is central to Aristotle's concept of rhetoric as an art. For entechnic rhetoric is concerned with the *πίστεις* and the enthymeme is the *σῶμα τῆς πίστεως*. In the enthymeme Aristotle has introduced into rhetoric his theory of the syllogism and has raised rhetoric to the rank of a legitimate discipline, since such an introduction is an acknowledgment that knowledge of the probable is valid, and may be used in valid inference.

To discover why Aristotle denotes rhetorical syllogism by enthymeme the term was studied in the pre-Aristotelian literature. Two meanings of the word appear to emerge, and from the term in Aristotle it appears that both meanings were operative in his selection of the word. Prior to Aristotle enthymeme seemingly signifies (1) something more than "thought," something more properly akin to the result of the operation of intellect and appetite; (2) secondly, in the technical language it acquires the notion of a rhetorical figure of style and thought founded in the idea of contrast and opposition. In the Aristotelian enthymeme these would represent its content (1) and form (2).

In Aristotle the key to the solution of the enthymeme is to be found by correctly locating rhetoric in the realm of practical philosophy: knowledge ordered to action. The text of the *Rhetoric* demands this. Once this is done the enthymeme assumes an intelligent position as the entechnic method of rhetorical demonstration which makes use of its intellectual (*πρᾶγμα*) and psychagogic (*ἦθος* and *πάθος*) sources to produce *πίστις*, just as the scientific syllogism uses its sources to produce *ἐπιστήμη*. Furthermore rhetoric, correctly located, makes it possible to understand how the enthymeme may (as it does) represent not only the probable demonstration of the dialectical syllogism (*Topics*) but also at times the certain demonstration of the scientific syllogism (*Analytics*). For in trying to establish *pistis* concerning his assumed thesis the orator may use certain and probable principles and propositions. Again the particular logic of the *πίστεις* and their relation to the enthymeme become clear. Rhetoric is directed to belief (or credential knowledge) ordered to action. Such knowledge implicates intellect and will as essential causes. Both of these causes, however, are the concern of the Aristotelian *πίστεις*: *ἦθος*, *πάθος*, *πρᾶγμα*. These three sources of *pistis* are directed to nous and orexis, and the purpose of the first and part of the second book of the *Rhetoric* is to analyse for us the nature of special topics (the *εἰδῆ*) on these *πίστεις*. From these arise the propositions and premisses of enthymemes are formed. These are then ordered into the inferential form of a syllogism (quite often elliptical in nature) by the general topics which are logical forms for argumentation by enthymeme.

This means that the enthymeme is not the third *πίστις*, as has been commonly assumed, e.g. the merely rational demonstration of one's proposition. It is not one of the three entechnic *πίστεις*: *ἦθος*, *πάθος*, *πρᾶγμα*. Rather it is an instrument as any syllogism is,

and its instrumental function is to order these three pists into an inferential form most effective for establishing belief. The object of the enthymeme which is the demonstration of rhetoric is not noetic knowledge, but practical knowledge: knowledge ordered to action. Such knowledge demands intellect, will, and emotions. To achieve this goal the enthymeme which in form is syllogistic employs as the matter, or content, of its demonstration the three $\pi\acute{\iota}\sigma\tau\epsilon\iota\varsigma$.

The enthymeme is thus the key to the Aristotelian synthesis which makes rhetoric a legitimate discipline.

325 pages. \$4.20. Mic 57-2133

LANGUAGE AND LITERATURE, LINGUISTICS

THE PATRONYMIC SURNAMES IN UKRAINIAN

(Publication No. 20,793)

Jacob P. Hursky, Ph.D.
University of Pennsylvania, 1957

Supervisor: Dr. Anthony Salys

This study attempts to present its subject on the basis of a selected listing of patronymic surnames collected from sources dated from the 14th century to the present time. The introductory chapter chiefly contains information about the literature on Ukrainian surnames, principles that have been the guides in the choice of sources, purpose and scope of the present study, and a few brief observations on the development of patronymic surnames in Ukrainian. Chapter II is designed to trace the historic development of patronymic suffixes. Chapter III is more broadly sketched; it is intended to show a great variety of patronymic surnames in relation to the meaning of the words from which they originated. Chapter IV is devoted to an analysis of the basic phonetic peculiarities found in early patronymic surnames. Chapter V deals with the accentuation and declension of contemporary patronymic surnames, while the final chapter (VI) presents the chronological and geographic distribution of discussed surnames by means of tables, a map, and overlays for various periods of Ukrainian history.

Among the conclusions the most important are:

1. Most of the patronymic surnames which are now in common use in Ukrainian were introduced in the course of the 14th-17th centuries. (The period in which they began to assume an hereditary character varies so greatly that it is impossible to estimate the date more precisely.)

2. The patronymic surnames in Ukrainian were formed by means of the suffixes -enko/jenko/enok, -(ov)yč/(ev)yč/(jev)yč, -iv/jiv, -yn/jin, -uk/juk, -čuk, -ak/jak, -ja/a, -enja, -at/jat. Originally, the vast majority of these suffixes served to form diminutives, and only later did they acquire patronymic character.

3. Today, the most common patronymic surnames are those which end in -enko/jenko, uk/juk, -čuk, -(ov)yč/(ev)yč/(jev)yč. On the other hand, surnames in -ja/a, -enja, -enok, frequent in 16th-17th century sources, seem to have disappeared completely.

4. Patronymic surnames, in relation to the meaning of the words from which they are derived, may be grouped under the following five main heads:

- i) Surnames derived from Christian names.
- ii) Surnames derived from names designating occupation and social status.
- iii) Surnames derived from names of ethnic origins.
- iv) Surnames derived from names of local origins.
- v) Surnames derived from nicknames. (Of these there is an immense variety including names designating physical and mental peculiarities, animals and plants, social relationships, time periods, foods and beverages, domestic articles and items of clothing, the body and its anatomical parts, natural phenomena, numerals, etc.)

5. In view of their variations patronymic surnames -- like other surnames -- are of great value for the study of the life, conditions, customs, national character, and the standard of civilization of people in the Ukraine at the time when these surnames began to come into use. Apart from this, they are of the greatest significance for Ukrainian lexicography and for linguistic studies in general.

6. Phonetic features show that in the patronymic surnames of the 14th-17th centuries both the sound-changes characteristic of all dialectal groups of the Ukrainian language (change of ě to i; merging of y, i; change of ě, ě to y, etc.) and the sound-changes characteristic only of limited areas (confusion of e, y in unstressed position; occasional change of o to u in unstressed position, etc.) had taken place. Most of the phonetic features found in surnames, however, were not isolated from the common sound-changes, but rather conformed with the Ukrainian language system as a whole.

7. Contemporary patronymic surnames conform with the flexion of nouns, except that those ending in -iv/jiv, -ova/eva/jeva, -yna/jina have partly the nominal and partly the adjectival flexions.

8. From the standpoint of their geographic distribution nearly all types of contemporary patronymic surnames occur within each of the regional areas of the Ukraine, but not in the same proportion: the -enko/jenko type is very common in Central and Eastern Ukraine, while the surnames ending in -(ov)yč/(ev)yč/(jev)yč, -yn/jin, -yšin/jišyn, -iv/jiv are of most frequent occurrence in Galicia, and those ending in -uk/juk, -čuk in Volhynia and Podolia.

143 pages. \$2.00. Mic 57-2134

TELUGU VERBAL BASES: A COMPARATIVE STUDY (PARTS I AND II)

(Publication No. 20,798)

Bhadriraju Krishnamurti, Ph.D.
University of Pennsylvania, 1957

Supervisor: M. B. Emeneau

This work is a novel attempt in the field of Dravidian philology, which seeks to set up a basic phonology for Telugu on comparative and historical grounds and to make a thorough study of the derivation of the Telugu verb.

Phonology:

The Proto-Dravidian(PDr) phonemes have been set up and a comparative and historical account of each Telugu (Te.) phoneme is given using the material of the verbal bases. PDr has the following phonemes: /k c ʈ t̪ p, ñ ŋ n m, y v, r, l, ɭ l; a i u e o -/. Te. has the following phonemes: /k kh g gh c ch j jh ʈ ʈh ɖ ɖh t th d dh p ph b bh, h *ɭ ʂ ʂ s, ŋ ŋ n m, ɭ l, r r, y v; a i u e æ o -/; of these, the aspirated stops and affricates are introduced through the borrowed element of Indo-Aryan; so also are ʂ and ʂ; /ŋ r/ are lost in Modern Telugu and /f, æ/ are introduced.

Phonemic correspondences:

Initial:

- k- < *k- before all vowels except i ē.
- c- < *c-, and *k- before i ē.
- t- < *t-, *c-.
- p- < *p-.
- g- < *k-, sporadically *v-.
- j- < *c-.
- d- < *t-, *j-.
- b- < *p-; *v- in loan-words from Kannada.
- s- < *c-; *s- of IA.
- n- < *n-, *ñ-.
- m- < *m-.

Non-initial:

- g- < *y-, *v-, *k-.
- j- < *c- (Rare).
- ɖ- < *t-, *ɭ-, *ɭ-.
- d- < *t- (< *t-, *c-).
- b- < *v-; rarely *p-.
- s- < *c-.
- n- < *n-
- m- < *m-, *v-.
- y- < *y-
- y < *y, *c.
- r- < *t-.

Initial ɖ-, r-, r- and l- occur in Te. through metathesis attended by vowel contraction under certain conditions. Initial consonant clusters with -r as the second member

have also resulted through the same process. Voiceless stop geminates result from two sources: 1. by doubling the root-final single stops of the parent language, 2. by the assimilation of a root-final liquid with the following voiceless stop. Voiced stop geminates always result from assimilation. -rr(u) and -vv(u) are usually contractions of the sequences *-r-iyu and *-v-iyu; the remaining sonorant geminates are traceable to single consonants in PDr doubled in Te. in the root-final position. The formation of consonant clusters in the non-initial position is described in detail.

Phonemic correspondences in vowels are difficult to organize. In general, all PDr vowels are preserved in most of the languages when they occur long. The majority of the alternations in vowels are attributable to the influence of the preceding or following phonemes. The main alternations are: ǣ-/ē- after *ñ-, *c- and *y-; alternation between higher and lower vowels before the retroflex consonants and *y; the falling together of PDr *i *u with *e *o in PSDr as preserved by Te. and Ka.; Ta. and Ma. shifted the occurrences of these vowels to *i *u. Arguments are given toward these conclusions.

Diphthongs in PDr can be interpreted as sequences of *ay and *av on structural grounds. In Te. ai and au freely alternate with ayi and avu respectively.

In Te. and the other literary languages, heavy bases (those with radical long vowel) alternate with light bases (those with radical short vowel), when vowel derivatives follow. Sometimes this vowel (i.e. derivative) is lost between consonants but it can be reconstructed on comparative evidence.

Etymological Analysis:

Telugu, Old and Modern, has a combined total of 1236 verbal bases, most of which are either dissyllabic or trisyllabic. Nearly twenty per cent of these bases are primary formations and the rest secondary formations. All primary formations are traceable to unaffixed root-morphemes of the following sequences in PDr: (C)VC or (C)V̄C with phonologically conditioned alternants in final -u. Secondary formations are traceable to earlier sequences which include derivative suffixes. On the basis of history and syllable structure they can be analyzed into three types in Te. as follows:

Type A: (C)VC-V, (C)VC-CV, (C)V-CCV, (C)V̄-CV, (C)V̄-CV/(C)V̄-~CV

Type B: CV-CCV, C̄V-CV, CCV-CCV, CC̄V-CV

Type C: (C)VC-VCV/(C)VC-V̄CV.

~ is phonemically a zero but historically points to a nasal phoneme lost in Te., however preserved in traditional orthography. - is a mark of etymological boundary which separates the root element from the derivative suffix. Of the above types A and B belong together in both being dissyllabic; C is always trisyllabic. Historically and etymologically Type B belongs to Type C in that it can be resolved into Proto-South Dravidian sequences of the type (C)VC-VC(V). In all these types, it is possible to reconstruct the root syllables for PDr or PSDr in the majority of cases. Reconstruction of the derivative elements is possible only in individual cases and for certain series of suffixes, e.g. velars and dentals. The distribution of suffixes is given on a comparative basis and isoglosses are set up wherever possible.

A formula is set up as follows for PDr to which all Dravidian verbal bases can be traced in structure: L = A sonorant: m, n, ŋ; l, ɭ; r; ɭ; y, v; P = Stop or affricate: p, t, ʈ, ʈ, c, k; NP = Nasal homorganic with the following stop or affricate: P = mp, nt, nt, nt, nc, nk; PP = pp, tt, tt, tt, cc, kk.

Root + Suffix

(C)V̄ + L
P
NP
PP
Ø
(C)VC+V
VL
VP
VNP
VPP
Ø

693 pages. \$8.80. Mic 57-2135

DESCRIPTIVE ANALYSIS OF
THE KURDISH OF SULAIMANIYA, IRAQ

(Publication No. 21,333)

Ernest Nasseph McCarus, Ph.D.
University of Michigan, 1956

This dissertation is a synchronic description of the phonology, morphology, and syntax of Sulaimaniya Kurdish. The corpus of data was obtained by the author in the field as a member of a University of Michigan expedition to Iraq and Iran in 1951. Texts were recorded in phonetic notation from several literate adult male natives of Sulaimaniya, and covered a period of four months.

In Chapter 1 there is a description of the gathering of the data, with an accounting of the primary and secondary materials. The status of previous studies on Kurdish is described, with brief annotations of certain of the works. There is also presented in this chapter a correlation of native Kurdish orthographic systems with the phonemic system arrived at in this thesis.

In Chapter 2, the following linear phonemes are described: nine vowels, i ɪ e ɛ a ɪ u ʊ o, and thirty-one consonants, p b, t d, k g, q, ʔ; c j; f v, s z, ʃ, ʒ, x g, h C, h; m, n, ɳ; l, ɭ; r, ʁ; w, y. The distribution of vowels and consonants and syllable structure are also presented. Prosodic features treated are lexical stress (two stress phonemes), sentence stress, and intonation (three pitch phonemes and three simple pitch morphemes). Also described in this chapter are morphophonemic process involving vowels and consonants.

Morphology treats of the structure of words, and syntax treats of the structure of utterances of more than a word. Morphology is presented in Chapter 3, Form Classes and their Inflections, and Chapter 4, Word Formation. Form classes are formally defined by their inflections; they are noun, adjective, pronoun, verb, and particle. The noun is regularly inflected for definition (definite or indefinite) and number (singular or plural); some nouns may be inflected for locative or vocative functions. The adjective is inflected for definition, number, and comparison (compara-

tive or superlative). The pronoun shows person and number. Verbs are inflected for person and number, aspect, transitivity, tense, mood, and voice; they may also show pronominal goal and negations. The particles are indeclinables, and are subdivided into interjections, conjunctions, interrogatives, numerals, prepositions, adverbs, demonstratives, and relatives. Two sets of suffixes, the "pronominal suffixes" and the "verbal suffixes," play an important rôle in the inflections of the form classes. For example, in certain tenses of the verb, person and number are indicated by the pronominal suffixes on transitive verbs but are indicated by the verbal suffixes on intransitive verbs.

Word formation processes in Kurdish are reduplication, compounding, and affixation.

Chapter 5, Syntax, treats of the structure of utterances larger than a word: nominal and verbal phrases, both minimal and expanded, and clauses. Under clauses are described subject, object, clause word order, order of modifiers, and sequences of clauses. An unusual feature of Kurdish syntax is the shifting of subject suffixes of verbs and the object suffixes of prepositions to other words in the clause under certain conditions.

The Appendix contains two illustrative texts in phonemic transcription with interlinear as well as free translations.

158 pages. \$2.10. Mic 57-2136

A PHONEMIC AND MORPHOLOGICAL ANALYSIS
OF SOUTHERN PUGET SOUND SALISH

(Publication No. 21,210)

Warren Arthur Snyder, Ph.D.
University of Washington, 1957

The southern Puget Sound dialect of Salish was spoken by a number of tribes along the shores of Puget Sound and inland. The language was spoken from just north of Seattle southward to the end of the Sound and then northward to the end of the Kitsap peninsula on the western side of the Sound. The people who spoke this dialect include such tribes as the Duwamish, Snuqualmie, Muckle-shoot, Puyallup, Nisqually and Suquamish.

Phonemically the language has only three vowels, but these have a wide range of allophonic variation. There are thirty-four consonant phonemes with very little allophonic variation. Consonant clusters are frequent. The only suprasegmental phoneme is the stress phoneme. Several types of juncture occur. Morphophonemic changes are not numerous.

Word classes include verbs, nouns, auxiliaries or modifiers, pronouns, particles and numerals. The verb complex is of central importance in the language. It consists of roots, prefixes and suffixes. Prefixation is relatively simple since there are only a few verb prefixes. Suffixation is complex. There are many verb suffixes.

The inflection of nouns is much simpler than the inflection of verbs; however, the derivation of noun stems is complex. There are some simple noun stems, but the majority appear to be derived from verb roots or verb roots plus verb affixes. In some examples it is difficult to classify words as either nouns or verbs. Similarly in

the case of auxiliaries or modifiers, it is sometimes difficult to distinguish between them and verbs.

Pronouns are used profusely, particularly the demonstrative pronouns which, in the great majority of utterances, occur as introducers of the verb complex, nouns and other pronouns. There are only a few particles (uninflected free forms) but these few appear frequently in connected speech.

Various types of reduplication occur to indicate certain semantic categories. Reduplication occurs most frequently with verbs and nouns to express the plural or repetition and the diminutive. The plural and diminutive may be expressed together. Reduplication has been found to occur occasionally with auxiliaries or modifiers, pronouns and numerals. 123 pages. \$2.00. Mic 57-2137

LANGUAGE AND LITERATURE, MODERN

ELLEN GLASGOW: SOCIAL CRITIC

(Publication No. 21,049)

Martha Marie Briney, Ph.D.
Michigan State University, 1956

The purpose of this study is to discover the extent and significance of the social consciousness which Ellen Glasgow revealed in her novels, specifically to investigate her attitude toward the poor-white, the Negro, the artist and the intellectual, formalized religion, the status of the Southern gentlewoman, and the New South.

The method is implicit in the problem. The writer examined the novels in chronological order and collected observations on the topics cited. Wherever feasible, she has presented the evidence in the language of the novels. It has also been correlated with what Miss Glasgow had to say on these topics in her autobiography and in her articles of social and literary criticism.

Ellen Glasgow dealt honestly and sympathetically with the poor-white; however, because in her full length portraits she depicted exceptional members of the group rather than typical ones, the resulting picture, while valid, is only partial. Its truth, therefore, is limited and its final importance "initiatory rather than intrinsic."

Her earliest portrayals of the Negro fall largely within the plantation tradition, but when one reads her novels chronologically, one notes that although her concern with the Negro is a minor one, her portrayal of him is fair, and her presentation of the racial problem is marked by honesty and increasing realism.

Ellen Glasgow regarded traditional Christianity as an outworn code. To her veneration for the Episcopal Church had crystallized into the worship of customs, and the blood symbolism emphasized in Calvinism was repellent. Despite this, her novels show increasingly a recognition of man's need for a religion that will satisfy and grudging respect for Calvinism.

Ellen Glasgow presents the Southern gentlewoman as a victim of male chivalry, of the Pauline dicta, and of woman's own acquiescence. She was not a militant feminist, but she was continuously concerned with the problem of

self-realization for women, a problem, however, which she nowhere solved.

In her handling of the artist and the intellectual in a hostile society, Miss Glasgow showed increasing realism and understanding. She moved from a romantic or satiric treatment to one which was marked by realism. A certain detachment which had marked her earliest treatments yielded, finally, to an impassioned protest against the anti-intellectualism of the South and of America.

While Miss Glasgow's endorsement of the New South was never uncritical, it was increasingly qualified. She approved of the infusion of new blood, but decried mistaking change for progress, the political isolation of the South, drowning the spiritual in the material, creating a culture without beauty, and failing to treasure priceless heritage.

Ellen Glasgow's achievement falls within two spheres, the social and the ethical. She showed a high degree of responsible social consciousness, and, in this respect was a pioneer; and she worked out a way of life which, although not religious, met the needs of an essentially religious nature that could find no satisfaction in traditional religion.

Ellen Glasgow ended life as she had begun it--in intellectual revolt. 612 pages. \$7.75. Mic 57-2138

ITALIANATE COURT SATIRE AND THE PLAYS OF JOHN MARSTON

(Publication No. 20,574)

Robert Sanford Brustein, Ph.D.
Columbia University, 1957

This study discusses the background of a single dramatic convention of the Elizabethan-Jacobean drama. On the assumption that the Italianate court, as employed in the plays of John Marston, was the expression of anti-court hostility which appeared first in satire, it traces the history of anti-court satire in English from the middle ages to the end of the sixteenth century. It shows that a flourishing medieval tradition of anti-court satire (under classical influence) reached its pinnacle in the writings of Barclay, Erasmus, Skelton and Wyatt. The study further shows how, in the middle of the sixteenth century, this medieval tradition was modified by increasing antagonism for Italy and, especially, for the Italianate courtier. It proves that the Italianate courtier, imitating the fashions of Italy, had come to be identified with Italy's villainies and fopperies. It is seen how satirists began to assert that the English court itself was in danger of becoming Italianate--that like the Italianate court it was troubled with murders, adulteries, poisonings, and with extreme affectation--and how, in consequence, the medieval English anti-court tradition was refocussed and redirected as satire against the Italianate court. Anti-court satire, in this form, is shown to be present in the works of Gascoigne, Lyly, Spenser, Nashe, Greene, Donne, and the formal satirists (Marston is one) writing in the nineties.

The second chapter is devoted to a study of the courtier as seen by Marston's contemporaries and his immediate predecessors. The courtly Castiglione ideal is compared with the satirical view of the Italianate courtier, the upstart, and the carpet-knight. The social accomplishments

of the Castiglione courtier are seen, in the satiric view, to be fopperies and villainies. The specific charges against the Italianate courtier are examined in detail: idleness, flattery, parasitism, effeminacy, overrefinement in clothes and speech, and lechery. Against this is set the character of the "plain-dealer," the Italianate courtier's anti-type, opposed in every particular to the Italianate courtier's vices.

The third chapter is devoted to a study of the satiric view of the court lady. This satire is seen to be a part of a wider satire on women in general, another heritage of the middle ages and of classical writers like Juvenal and Seneca, but intensified by the contemporary notion that the court lady, because of the seductive blandishments of the court, was particularly susceptible to the amorous suggestions of courtiers. The particular vices of the court lady--among them idleness, painting, adultery, weakness of will, and masculinity--are examined in detail, and the Elizabethan character of the good woman is set forth.

The fourth chapter demonstrates how the satiric views of the Italianate court, the Italianate courtier, and the court lady found their way into Marston's plays, and how he developed these views from essentially satiric ideas into dramatic conventions. 346 pages. \$4.45. Mic 57-2139

MANUEL FERNÁNDEZ JUNCOS: PIVOTAL FORCE
IN THE INSULAR MOVEMENT OF
PORTO RICO THROUGH EL BUSCAPIÉ

(Publication No. 21,156)

Frank Gaetano Carrino, Ph.D.
University of Michigan, 1956

The purpose of this study was to examine the several phases of the nineteenth century insular movement in Porto Rico that were largely initiated by El Buscapié, under the editorship of Manuel Fernández Juncos. As the most widely circulated periodical of the era, the only one aimed at literary, educational, social, and economic progress as well as the political orientation of the public, and as the periodical with the longest sustained publication, El Buscapié dominated the 1877-1899 era in Porto Rican cultural development. Its editor emerged as the only insular writer who devoted himself to newspaper publishing, for which he was internationally acclaimed for his insular efforts through honorary memberships in literary, educational, and scientific societies, through public eulogies, honorary degrees, and public offices.

Complete issues of El Buscapié, together with all existing works by or about Fernández Juncos, were consulted in the Insular Library of San Juan, Porto Rico, the University of Porto Rico Library at Río Piedras, and the Library of Congress, Washington, D.C. Adding significant information to the study were personal interviews with surviving members of the Fernández Juncos family and former students, associates, and friends of the editor.

Complete evidence of Porto Rico's first great surge of insular activity is enclosed within the twenty-three year span of El Buscapié, during which the periodical sought equality for Spaniards on the island and on the peninsula, in spite of censorship restrictions and frequent suppressions. Seven general conclusions may be drawn from this

evidence: (1) El Buscapié revived and encouraged insular writings by providing a place of publication, providing prizes and announcements of literary competitions, and by affording publicity and literary criticism, as well as wide circulation among the reading public of the island. (2) El Buscapié organized a program for libraries and reading centers and secured books for each. To encourage the establishment of personal libraries, translations of foreign works were printed in a form suitable for binding. First suggestions were made for an insular library, for which Fernández Juncos was selected as first librarian. (3) El Buscapié successfully propagandized for a compulsory public educational system to train future citizens, and for the establishment of schools of commerce, agriculture, pharmacy, arts and crafts, and teacher training. (4) This was the only periodical promoting an organized adult education program by means of informative articles on health, welfare, and government problems that were deemed necessary for an informed citizenry capable of participating in the island's current affairs. (5) El Buscapié was the only periodical intent upon identifying, challenging, and when necessary denouncing the policies of the Madrid-dominated government in Porto Rico which was impeding insular economic and social progress. (6) El Buscapié assumed political leadership on the island in the drive for autonomy and viewed the successful accomplishments of autonomy in the wake of international crisis and fighting on Porto Rican soil. (7) El Buscapié had the longest sustained influence of a periodical published in the interests of insularism, during a period in Porto Rican history when periodicals dominated the literary scene.

173 pages. \$2.30. Mic 57-2140

MILTON'S AREOPAGITICA: AN ANALYTICAL AND
HISTORICAL STUDY, WITH IMPLICATIONS
FOR THE COLLEGE TEACHER

(Publication No. 21,135)

Robert Wallace Cox, Ed.D.
University of Michigan, 1956

The purpose of this study is to describe the reception of Milton's Areopagitica from 1644 to the present time. Attention is directed chiefly to ideas, and only incidentally to form. Such a study is justified because of the high position accorded to Areopagitica in English literature, and because a study of changing estimates leads to a sounder appraisal of Milton's discourse. This study, then, describes how Areopagitica has been assessed by British commentators from the seventeenth century to now. These assessments suggest the present relevance and worth of Milton's ideas as expressed in Areopagitica, as well as implications for the college teacher of this essay.

This study is limited to the work of British commentators, with the exception of three French critics whose work seems influential in the British reception of Milton. The result has been a body of material sufficiently limited to allow detailed examination, but not so limited as to preclude sound generalization.

Chapter II is concerned with reception of the essay in the seventeenth and eighteenth centuries, and shows that Areopagitica is hardly noticed in the seventeenth century,

and that before 1800 it is only infrequently cited as one of Milton's better prose works. The critic's attitudes, political and religious, are major determinants of his estimate before the nineteenth century. Chapter III shows that in the nineteenth century *Areopagitica* is frequently lauded as the best, or one of the best, of Milton's prose works, despite noticeable anti-puritan prejudice. Nineteenth century acclaim is usually justified by praise for the stylistic quality of *Areopagitica*, or by assertion of Milton's high rank as a patriot. With few exceptions, however, the commentaries cited are notably superficial in their treatment of content: Milton is frequently classed as a great liberal, and *Areopagitica* is usually discussed as an occasional appeal for uncensored printing.

Twentieth century commentaries, with nearly complete absence of anti-puritan prejudice, usually praise the essay highly and emphasize Milton's thinking. There is continued praise for Milton's style, but the more recent writers also value *Areopagitica* as a body of ideas important for an understanding of Milton's mental development, and as a statement of liberal principles. Discussion of these principles does not result, however, in thorough definition of the liberalism in *Areopagitica*; Milton's numerous exceptions to the full application of the principle of liberty are imperfectly recognized.

Chapter V is an analysis of *Areopagitica*, and shows that (a) understanding of its oratorical form is necessary for accurate comprehension of Milton's position; that (b) the essay is important as a plea for uncensored printing and as an argument for freedom in principle; but that (c) Milton's concept of freedom permits numerous limitations of individual and civil rights.

From these results the following conclusions are drawn. Imperfect historical perspective has resulted in misinterpretation of *Areopagitica*. Further, critics have often been preoccupied with form at the expense of content. The most important conclusion, however, is that *Areopagitica*, a notably teachable essay, includes ideas significant for mid-twentieth century readers. Milton speaks to totalitarianism and to Democracy, and also makes appropriate observations on the nature of truth.

227 pages. \$2.95. Mic 57-2141

UNAMUNO'S THOUGHT AND GERMAN PHILOSOPHY

(Publication No. 21,112)

Oscar Adolf Fasel, Ph.D.
Columbia University, 1957

This dissertation deals with the Spanish essayist Miguel de Unamuno as a man who struggled with ultimate questions, who searched to find the Christian answer. Thus, the investigation lies on another level than the literary. The problem is Unamuno's philosophy and theology.

The dissertation is divided into five parts, each of which attempts to establish Unamuno's use of a particular phase of German cultural thought.

Hegel's reconciliatory attitude toward life's contradiction, with its stress on the universal principle, appears in PART ONE in Unamuno's acceptance of the scientific method, "la ciencia," as a synthesizing activity.

PART TWO deals with Unamuno's reaction to Hegel's

antagonists, Schopenhauer and Nietzsche. It shows that Unamuno's emphasis on man's spiritual growth toward unity and universality was not affected by Schopenhauer's and Nietzsche's opposite points of view, that Schopenhauer's influence was merely indirect. Nietzsche's philosophy offered an even greater challenge to Unamuno than the spiritual paralysis produced by the pessimistic intellectual temper of Schopenhauer's thought. Nietzsche's "Uebermensch" was to Unamuno the anti-thesis of his own goal - man's universal reality. In his character of separation, distinction, and differentiation Unamuno saw the negation of man's striving toward unity. Equally antagonistic to Unamuno were Nietzsche's irreligious views, his Antichrist, his concept of the Eternal Recurrence.

PART THREE takes up Unamuno's theological orientation. After two decades of keen interest in literature and philosophy, the 1880's and 1890's, Unamuno turned to the study of theology. The foremost theological school of his time, the Ritschlian, drew his attention in particular. Albrecht Ritschl and Adolf von Harnack, the former the founder of the Ritschlian school, the latter its foremost representative, were the two theologian-historians referred to by Unamuno whose influence overshadowed all others in this field. Their study introduced Unamuno to a long chain of theological problems and to the practical aspect of religious life. The trend of the times toward an existential philosophy of life was of great value to Unamuno in solving, in Harnack's words, "the question of the meaning of life."

PART FOUR is a study of Kant's position in Unamuno's work. Kant's philosophy became important to Unamuno after he was introduced to the theological struggle between reason and faith by Ritschl and Harnack at the turn of the century. It was then that Kant's criticism of reason, his concept of morality, his idea of God and immortality assumed meaning in shaping Unamuno's concept of religious truth.

PART FIVE is a study of Unamuno's interpretation of the spirit that lives in Goethe's dramas. They represented to him a great moral force, a testimony to the poet's understanding of the true meaning of religion.

The CONCLUSION makes clear that Unamuno's primary interest was Spain and that he saw German cultural thought in relation to this primary concern.

A comparison with the religious ideas of the Danish writer Soeren Kierkegaard seemed pertinent, and has been made. 253 pages. \$3.30. Mic 57-2142

THE USE OF PSYCHOANALYTIC IDEAS BY LITERARY CRITICS

(Publication No. 21,177)

Louis Benjamin Fraiberg, Ph.D.
University of Michigan, 1956

This study was made to examine the use of psychoanalytic ideas by literary critics. Its intention was to explore historically the promulgation of psychoanalytic concepts together with their vicissitudes as they made their way into individual works of criticism, then to evaluate what the critics had done with them.

The first four chapters constitute a presentation of the

development of psychoanalysis as it relates to problems of art. They are recapitulations of the work of Sigmund Freud, Ernest Jones, Hanns Sachs and Ernst Kris, respectively, arranged in chronological order. With some overlapping, this provides a connected account of the important stages of psychoanalytic thought and its increasingly complex application to literature by classical psychoanalysts.

The next six chapters study in detail those writings of the American critics Van Wyck Brooks, Joseph Wood Krutch, Ludwig Lewisohn, Edmund Wilson, Lionel Trilling and Kenneth Burke in which they use psychoanalytic ideas to judge particular literary works or to form critical theory. These chapters, too, are arranged chronologically, with some overlapping. The two parallel developments, the growth of psychoanalysis itself and its spreading use in criticism, as represented by the work of these men, are considered together point by point. Finally, there is a chapter summarizing the whole and presenting conclusions.

Brooks, Krutch and Lewisohn attained only a superficial understanding of psychoanalysis and apparently made no effort to keep up with its development up to the time they wrote. Basing their use of it partly on outdated concepts and even misreading established psychoanalytic doctrine, their critical use of it proved almost wholly unacceptable, Krutch subsequently repudiating his own work. Edmund Wilson attempted unsuccessfully to find psychoanalytic support for the Philoctetes myth as the paradigm of his theory that emotional illness is a necessary concomitant of artistic ability. He failed because he did not know that advancing psychoanalytic thought had already made such support impossible when he wrote his essay. Lionel Trilling, after some initial hesitation, acquired the best understanding of psychoanalysis which any critic has yet shown and not only applied it satisfactorily to judgments about writers but also used it creatively in critical theory, e.g., in extending Aristotle's idea of catharsis by the use of Freud's concept of the repetition-compulsion. Kenneth Burke, absorbed in his philosophical over-valuation of verbal motives for human actions, ignored its central concern with feelings and attempted to incorporate the lifeless remainder into his system.

The initial failure of nearly all these men was an unwillingness or an inability to discover what psychoanalysis was actually saying about the operation of the mind under the influence of the impulses. All except Trilling apparently remained unaware that psychoanalysis was a developing branch of science and that it consequently sometimes made clinical discoveries that necessitated alterations in theory. Only Trilling appears to have grasped the significance of current psychoanalytic ego psychology for the understanding of the creative process. If these men are representative, then it must be concluded that during the first fifty years of psychoanalysis American literary critics, with only a few exceptions, have misunderstood its scientific nature, not informed themselves sufficiently as to its teachings and misapplied it in their criticism.

393 pages. \$5.05. Mic 57-2143

MEMOIRS OF THE FRONDE. A LITERARY STUDY.

(Publication No. 21,114)

Felix Raymond Freudmann, Ph.D.
Columbia University, 1957

The Fronde (1648-1653) had its literary echoes. In that civil war culminated the social and political unrest of the Richelieu and Regency periods. The crisis also marked a turning point in artistic orientation: both absolute monarchy and the characteristic features of French literary classicism emerged around 1660, after the turmoil had subsided.

The vast memoir literature of the Fronde offers an invaluable approach to the study of this transition period. As happened during the religious wars of the sixteenth century and as was to occur again during the revolutionary period of the eighteenth, the upheaval caused this literary genre to flourish. Accounts were left by men and women of all walks of life and of opposing political factions, by princes, churchmen, magistrates, soldiers, and bourgeois.

From the direct testimony of such a rich variety of writers, the social structure of seventeenth-century France could thus be studied along the lines of its component strata. This self-suggesting sociological outline was used in our study, however, to serve in a rapid literary analysis. Starting with authors high on the ladder, we examined the writings of Mademoiselle de Montpensier, the Duke de La Rochefoucauld, the Duchess de Nemours, and the Cardinal de Retz in our first chapter ("Leaders among the Nobility"). In the next one, "Less Prominent Partisans," we studied the work of thirteen authors: Jean Vallier, Coligny-Saligny, Aymard de Chouppes, Henri de Campion, La Porte, Madame de Motteville, Montglat, Father Berthod, Gourville, Nicolas Goulas, Pierre Lenet, Claude Joly and Guy Joly. Moving somewhat like satellites in the orbit of various powerful figures, these writers reflected the views of their factions as well as their own.

Under the heading "Independents," in the following chapter we analyzed the accounts of Madame de La Guette, Louis de Pontis (written in collaboration with Thomas Du Fossé), the two Counts de Brienne, Daniel de Cosnac, and Valentin Conrart. It was felt, as the title implies, that each of these authors should be viewed apart from the political struggle, at least to the extent of justifying a separate classification.

The chapter entitled "Magistrates" deals with the voluminous works of Omer Talon and Mathieu Molé, two important figures. The former was *avocat général* at the Parliament of Paris during the Fronde, while the latter was *premier président* of the same judicial body.

Not all of this vast literary material was found to be on a high psychological or stylistic level. It was felt, however, that there existed no justification to relegate all of it to the historian's archives. Histories of literature usually mention only the *Mémoires* of Retz and La Rochefoucauld, with perhaps one or two others, among the century's true literary creations. In the course of our literary analysis, however, remarkable aspects of lesser known prose writers have come into focus. Henri de Campion, the Marquis de Montglat, Guy Joly, the Duchess de Nemours, and Jean de Gourville proved especially noteworthy in this respect.

This would indicate that further investigation into the relatively neglected field of the century's memoir literature

is doubly warranted. In the first place, more authors may be found possessed of above average literary qualities. Secondly, increased familiarity with the psychology and the stylistic evolution that can be observed in the numerous writings is highly desirable. Such knowledge can contribute significantly to a general understanding of the century which produced the classical masterpieces and in consequence to a more refined appreciation of the work of the great masters. 330 pages. \$4.25. Mic 57-2144

THE MAN AND THE POET IN THE WORK OF PIERRE REVERDY

(Publication No. 21,043)

Sarah Frances Jacob, Ph.D.
Tulane University, 1956

The object of this dissertation is to undertake a scholarly analysis of the work of Pierre Reverdy. Based upon his statement that one must begin with the man in order to arrive at the art, the study is divided into two sections. Part One, entitled The Man in the Work of Pierre Reverdy, includes three chapters analyzing his essential solitude, his religious conflict or search for reality, and his poetic anxiety. The first chapter describes the loneliness that pursued him as a boy in Narbonne and Toulouse, as an artist in Paris, and as a recluse at Solesmes. The second chapter deals with his struggle between doubt and faith and with his fluctuation between an inner and an outer reality. The third chapter presents the problems posed by his desire to find in poetry a means of achieving both self-expression and worldly recognition. Part Two, entitled The Poet in the Work of Pierre Reverdy, contains three chapters treating his general relation with modern poetry, the style and structure of his poetic works, and the obsessive images which constantly recur in his poems. The first of these chapters clarifies the position of the poet with regard to Cubism, Dadaism, and Surrealism--three movements with which his name has been associated. The next chapter reveals his conception of the creative process and his use of the image as the fundamental unit in structure and style. The last chapter shows how the emotional, poetic, and metaphysical anxieties that plague the man find expression in images that haunt the poet.

In a general sense Reverdy can be described as a poet-errant of Cubism and Surrealism, which continue in the twentieth century the profanely mystic voyage begun in the nineteenth century by Baudelaire, Rimbaud, and Mallarmé. Riding independently in the van of these movements, he employs ideas and procedures that determine his affinity to both groups. First, after the manner of the Cubists, he attempted to penetrate the absolute by fusing the concrete and the abstract into a single reality and by abolishing the human concepts of reason, time, space, and movement. Then, viewing with alarm the widespread abuse of an autonomous and irrational art, he began a resolute retreat toward the controls of logic, combating the unchecked nihilism of the Dadaists and the unbridled verbalism of the Surrealists. Although he rejected the theory of psychic automatism, along with the fetish of strained imagery and the cult of cynical absurdity, he accepted the dream as an access to the zone of transcendental tendencies, using the

technique of oneiric flux, but refusing to exploit the resources of subliminal hazard.

The structure and style of Reverdy's poetry are governed by three principles observed in Picasso's painting: le jaillissement, le dépouillement, and la saine réalité. Spontaneity is controlled by intelligence. Phrases are stripped to the bone, so that they stand in skeletal nudity upon the page. The connective tissue is absent, but the supporting frame is present. This fragmentation of the whole is visually represented by an irregular typography which, according to the author, eliminates the need for punctuation.

The poems, lying in the curve of their sequent images, have the hermeticism, not of fictive arcana, but of natural phenomena. Recurring constantly, the chief images, such as the wanderer, the wall, the mysterious presence, and the shadow symbolizing a dédoublement of personality, express a primordial anxiety that can never be stilled.

In voicing a new humanism as pessimistic as that of the Renaissance was optimistic and a new mal du siècle more desperate than the one that brought ennui to the minds of the nineteenth century, Pierre Reverdy stands on common ground with the Cubists, with the Surrealists, and with all other contemporary writers who, like the Existentialists, are seized by anguish and despair.

308 pages. \$3.95. Mic 57-2145

SYMBOLISM IN THE ANCIENT MARINER: A STUDY IN METHOD

(Publication No. 21,190)

Carl Francis Keppler, Ph.D.
University of Michigan, 1956

The problem dealt with by this study is that of the symbolic meaning of Coleridge's Rime of the Ancient Mariner. The purpose, however, is not only to advance an interpretation of the poem's symbolic meaning, but also to formulate and test a method of dealing with this specific problem.

In the earlier portion (Chapters I-IV), a survey of the interpretations that have been advanced since the poem's first appearance discloses certain outstanding weaknesses and limitations, which are found to be attributable to an underlying weakness of method: their common preoccupation with Coleridge as an individual, a figure which, because of our necessarily incomplete knowledge both of it and of its relationship to Coleridge's poetry, forms less a bridge between the critic and the symbolism he is attempting to study than a barrier. It appears that the problem of the poem's symbolism cannot be approached in a satisfactory way through inferences based on the personal life or the intellectual convictions of the author but only through a direct study of the poem itself. On the other hand, to attempt such a study by means of the critic's intuition or ingenuity alone is no more reliable than to attempt it through the medium of a study of the author.

It is therefore suggested that the concept of the "collective unconscious," as it has been called by Jung, offers both the most logical explanation of the phenomenon of symbolism and the most fruitful as well as most nearly objective method of studying this phenomenon, a method

which makes available to the critic, as external evidence on which to base his conclusions, the vast body of symbolic products other than the work under study: communal-traditional products such as myth, legend, and fairy-tale; individual-spontaneous products of unconscious origin such as dream and waking vision; and other examples of conscious art.

The latter portion of this study (Chapters V-VII) undertakes the application of the method which the earlier portion formulates. The principal images which occur in the poem are found to possess, not such equational meanings as signs or allegories, but general areas of value that seem to have been more or less constant through recorded human history. This study of the imagery is then applied to the interpretation of the poem as a whole, which is found to consist in the ancient drama of the crime of ego-consciousness expiated through growth, a growth centred in a multilateral but unified reconciliation of opposites within the psyche of the hero.

The conclusion to be drawn from this study, however, is not that its interpretation is the final and definitive one, for the concept of symbolism which it accepts makes such "final" interpretation impossible. The main conclusion that can be drawn is that the method which it suggests and tests--the study of symbolism based on preliminary research into the symbolic background of the imagery used--represents an approach to the symbolism of Coleridge's poem both more informative and more reliable than the methods which have been tried hitherto. The subordinate conclusion, implicit in the other, is that the method here applied to *The Ancient Mariner* is applicable also to other problems of symbolism in literature.

416 pages. \$5.30. Mic 57-2146

SYMBOLIC IMAGERY IN PEARL

(Publication No. 20,124)

William J. Knightley, Jr., Ph.D.
Princeton University, 1956

The imagery of Pearl is a symbolic imagery which is borrowed almost exclusively from Sacred Scripture and may be understood according to the poetics of Hugh of St. Victor, Dante, Petrarch, and Boccaccio. According to their theories the images and figures of a poem were to be searched for a more profound spiritual meaning, since poetry, like Scripture, would conceal the secrets of theology under cover of pleasant fictions. Thus the imagery of Pearl was studied for its possible spiritual meaning, a part of which had been discovered by other students interested in the poet's symbolism. The method of the study was to identify the scriptural sources of the imagery, and to define their spiritual meanings by reference to traditional interpretations in the commentaries, and, finally, to relate these meanings to passages in which the poet discusses explicitly the doctrines implicit in his imagery.

The results of the investigation may best be summarized under the familiar levels of four-fold interpretation, although the plan of the dissertation does not follow the same order.

Literally, the hero has lost a pearl in a garden. Like a seed it has produced spices, but yet, wilfully rejecting

Christ's comfort, he mourns it as completely lost. In a "ghostly" vision he sees another garden in which all is transformed; and beyond a crystal river he sees his pearl transformed as a maiden. She upbraids him for three errors which she says came about because he believes only what he can see with his eyes; and she tells him that she is the rose become a pearl become a maiden. In a long dialogue she and the dreamer discuss her right or title to her present glory which she explains by (1) the doctrine of the saints as kings or queens by "cortaysye"; (2) the parable of the laborers in the vineyard; (3) the doctrine of salvation by innocence and not by right; (4) the description of the Lamb without sin; and (5) the figure of the two Jerusalems, the old and the new. The dreamer asks for and is granted a sight of the New Jerusalem. There he sees the pearl in the procession of the 144,000 virgin-brides; whereupon delight entered his eyes and ears; he renounced his wretched will; and he concluded with a prayer that all men may also be reconciled to God.

Allegorically, the hero represents those members of the Church who by mortal sin have lost the sinlessness which is the *sine qua non* of the life in God that Adam lost in the garden, that Christ restored by dying in the second garden, and that flourishes in the garden of the Church. In the darkness of his sin, the dreamer, like Adam, possesses a wretched will, a darkened intellect, and is spiritually blind. He sees but does not understand, because he sees only with the fleshly eye. In the end, by "recta voluntas" he is reconciled to God and understands both the innocence of the Mystical Body and the mystery of the Sacrament which unites the Church to Christ. The pearl-maiden, on the contrary, represents the innocence of the life in God which (1) equates and confers a real dignity on the members of the Church; (2) is granted to all regardless of merit or past sins; (3) is the essential and necessary gift conferred in baptism or penance; (4) is that which makes us "similes ei"; and (5) makes the Church a prototype of the New Jerusalem from which all sin is excluded.

Tropologically, the hero is a man who has lost the sinlessness of sanctification and has put on again the old Adam of blindness, spiritual ignorance, and misery. By the mercy of God he is shown a vision of the life of those who have died to the old Adam and have been buried and reborn in water with the new Adam and arise transfigured in the newness of life. The new life, as it is called by St. Paul, is the burial and resurrection of the soul in baptism (or penance) and the *metamorphosis*, the transfiguration, or the complete change of being which accompanies participation in the life of God. The new life is (1) man's rebirth as a son of God whereby he becomes a co-heir with Christ to share His title and glory; (2) it is man's rebirth as a child of God to receive, unmerited and unearned, the gift of divine life; (3) it is man's conferred likeness to God who is perfectly sinless; (4) it is man's possession of that innocence which is typified by Christ the innocent Lamb; and (5) it is the antithesis of the old life of blindness as the *visio pacis*, the Holy City, which is the glory of the *mundicordes* who have been reconciled to God by being remade in His image and likeness.

Anagogically, the poet describes the innocence of celestial life which has been freely and mercifully extended to mankind in time by the mystical (i.e., sacramental, through the visible Church) death, burial, resurrection, and transfiguration of the soul which thereafter

walks in the newness of life that in all respects save the limitations of corruptibility is the same as the divine life that man will share as a co-heir with Christ the Lamb of God in the Heavenly City when "similes ei erimus, quoniam videbimus eum sicuti est."

255 pages. \$3.30. Mic 57-2147

**NARRATIVE ART AND HISTORY IN
ROBERT PENN WARREN'S
WORLD ENOUGH AND TIME**

(Publication No. 21,193)

Calvin Warren Lane, Ph.D.
University of Michigan, 1956

The purpose of this study is to examine the narrative art of Robert Penn Warren's novel of violence in frontier Kentucky, World Enough and Time. The main problem involves the reconciling of the aesthetics of the historical novel (the limitations imposed by historical fact) with an analysis of the novel's structural organization. Although an author is under no obligation to keep to the data of history, he must be true to a sense of the past and to a delineation of characterization and setting generally similar to the known records.

Warren has always been preoccupied with the clash between individual ideas of right action and those of society, and the need of the individual to define his own "being." Thus, the bizarre interplay of murder, politics, and misplaced idealism in the Beauchamp-Sharp affair offered him an appropriate vehicle for a novel. If one examines the nature of the source material, other novelists' use of the source as compared with Warren's, the dramatic structure of the novel, and related matters of ambiguity and symbol, a value judgment can be made as to Warren's degree of success in informing World Enough and Time with a meaningful thematic pattern. The concern is with the totality of effect of all the components of the novel,--the ordering of fact, structure, etc.,--not the transitory matter of Warren's exactness in transcribing fact.

The Beauchamp-Sharp affair's melodramatic emphasis on retribution and revenge presents nearly intractable problems of adaptation; consequently, the novelists who preceded Warren in adapting the source were unable, or unwilling, to do other than to perpetuate local fable. In particular, Simms' attempt, in Beauchampe, to glorify "the natural romance" of the frontier is in marked contrast with Warren's ironic connotation of "romance." While Warren based his novel on the narrative outline of Beauchamp's Confession, and made use of contemporary documents, he altered minor details to conform to his own reading of the source, yet remained true to the spirit, if not the law, of historical fact.

The sense of time running out for Jeremiah Beaumont, the influence of character on action, and the intensification and limitation of the area of action, give the novel its dramatic character. Until the novel's climax the action evolves from the need of the hero to justify, in the eyes of the world, the killing of Fort. But following the climax, the dramatic effect is weakened when it is revealed that Beaumont has acted not from necessity but because of the crudest of external causation.

Similarly, the novel's use of ambiguity remains a qualified success, for in the applying of his critical theories about poetry to the writing of fiction, and in the process of setting up opposed ideas in compliance with "the arduous obligation of the intellect," Warren has made no clear distinction between his comment, as narrator, and Beaumont's reflection on the course he is undertaking.

The novel's symbolism is more effective than its ill-defined use of ambiguity. In the articulate formulation of symbols of "world," "time," "innocence," and the recurrent motif of blood imagery (often rising to the symbolic), may be found the novel's most satisfactory statement of theme, for concepts such as "world" are given specific meaning by the differing attitudes held toward them by each of the main characters.

In retrospect, the skilful unfolding of the action via the presentation of the Kentucky of the 1820's as a land of paradox, and Warren's refusal (in the dilemma of the hero) to balk at life's complexities, give the novel stature, even though it is not an aesthetic whole.

193 pages. \$2.55. Mic 57-2148

**CONRAD AND THE "ATMOSPHERE OF
AUTHENTICITY": AN INQUIRY INTO THE
STRUCTURE AND MEANING OF CHANCE**

(Publication No. 21,327)

Gerald Henry Levin, Ph.D.
University of Michigan, 1956

The purpose of this study is to examine the psychological realism of Chance and its "Impressionism," what Conrad called the "New Form of the Novel." Chance was the culmination of Conrad's effort to represent limited and emergent consciousness, and to render experience as it registered in the consciousness of an intelligent observer. The problem is to discover why Conrad discarded conventional methods of characterization and whether the method of Chance was developed merely as an experiment in pure technique. The aim is to discover the relationship between the structure and meaning of Chance.

In Chapter II, the theory of the "New Form" and Conrad's conception of psychological realism is traced. Since Conrad was influenced by the French realists and Henry James, it is important to understand his theory of fiction in the light of their ideas. This approach may explain why Conrad used "reporter" and interpreter characters in Chance. But an understanding of his theory of fiction can only establish intention in a partial way. In Chapter III, Lord Jim, Nostromo, "Heart of Darkness," and Under Western Eyes are studied to establish Conrad's typical method of characterization before Chance, and to examine the relationship between structure and meaning. These considerations prepare for the intensive analysis of Chance to discover its thematic patterns and the technique created to express them.

Analysis of the earlier works and Chance shows that Conrad centered awareness in interpreter characters when the principal characters realized only partial or no insight, or when the emphasis was on the effect of the experience of the principals or the interpreter characters. When the emphasis was on the meaning of experience

rather than on its effect on the principals, Conrad sometimes used several interpreter characters to convey different views of the central situation. When the emphasis was on the effect of the experience on the principals, Conrad used interpreter characters to discover the true motives for the action. Unlike James, Conrad did not depict consciousness directly. The interpreter characters communicate different views of the situation and judge the principals by different standards. The structure of *Chance* explores the themes of determinism, destiny, and moral responsibility by moving from examinations of consequence to considerations of motive by means of elaborate time-shifts. The complex method of *Chance* is one solution to the thematic problems of the novel. The Impressionistic devices of *Chance* convey the effect of life as an intelligent observer experiences it, but most of these devices are used because of the requirements of the theme. The devices used to convey time intervals seem to be developed as pure technical considerations.

Several conclusions may be drawn from the study.

1) *Chance* is not an experiment in pure technique. 2) Its complex method is equally the result of a general theory of fiction and of major thematic requirements. 3) Immediacy is sacrificed to the indirect method of characterization and the literal representation of time intervals.

197 pages. \$2.60. Mic 57-2149

**NATHANIEL LEE'S *THE RIVAL QUEENS*:
A STUDY OF DRAMATIC TASTE AND TECHNIQUE
IN THE RESTORATION**

(Publication No. 21,485)

Nancy Eloise Lewis, Ph.D.
The Ohio State University, 1957

Nat Lee's *The Rival Queens*, or *The Death of Alexander the Great* is a suitable focal point from which one can study varying aspects of Restoration tragedy, a genre which has received limited critical attention. In the first place, Lee's choice of subject reveals the dramatic climate of the late 1670's and the interests of the fashionable world for which the Restoration theatre existed. Alexander the Great was a familiar figure to Lee's audience because of the prevalence of the Alexander romance in England since the Middle Ages, the widespread knowledge of classical historians, and the popularity of La Calprenède's *Cassandre*, a French romance which concerns Alexander and his world. However, Alexander was a virtual stranger to the English stage.

Lee's choice of a protagonist helps to define the special qualities of Restoration tragedy, for Alexander was a figure admirably suited to the requirements of the genre. The selection of a hero from the classical Orient is, in all probability, partially due to the widespread interest in the East during the Restoration, as evidenced in dramatic and non-dramatic literature, court fashions, and entertainments. A major reason for such interest appears to be the prosperity of British trade with the East at this time. Men of wealth and property, who composed the theatre audiences, were frequently stockholders in British trading companies. Other probable reasons for Restoration interest in the East are the numerous printed reports of

returned travelers and the popularity of the East in French economy and culture, which had a marked influence in France-conscious England. Thus Lee's choice of subject reveals tastes and interests of the Restoration audience.

An analysis of *The Rival Queens* as tragedy shows its strength in comparison with most plays of its own age and its limitations as great tragedy. It is skillfully constructed, with renowned characters and rapid action. Lee's knowledge of what makes good theatre and his familiarity with pre-Restoration tragedy enabled him to select, change, or reject characteristics of the typical heroic play, and these changes in theme and structure strengthen the play. Nevertheless, the absence of real conflict and the substitution of sensational incident for thought and feeling make the play shallow.

A study of *The Rival Queens* in its dramatic milieu, however, shows that it is representative of its age. A sound theatrical sense enabled Lee to adapt his play to acting styles, stage conventions, and the talents of the specific group of actors for whom he wrote the play. His success in making use of these elements is revealed by the long stage history and constant critical attention accorded the play. *The Rival Queens* was performed in London and elsewhere for almost two hundred years.

Lee's play had considerable dramatic influence. It marked the beginning of a series of "Alexander" plays on the seventeenth-century stage, and its influence is further reflected in a number of plays with elements similar to those in Lee's tragedy. *The Rival Queens* appeared at a time of changing styles in serious drama, and there is reason to believe that it helped shape the style of subsequent seventeenth-century tragedy. It also reflects dominant dramatic influences without being directly imitative.

In its adherence to elements of the Restoration heroic plays, in its use of dramatic practices of the Elizabethans and Jacobean, and in its successful arrangement of such material into a play that is impressivelyactable, *The Rival Queens* illustrates the nature of Restoration tragedy more adequately than other plays which conform more rigidly to only one dominant dramatic influence of the time. The genre is, one concludes, atypical. *The Rival Queens* illustrates the elasticity of the term "Restoration tragedy," and in form, subject, and stage history it reveals the dramatic taste and technique of the Restoration.

162 pages. \$2.15. Mic 57-2150

**THE PASTORAL AND HEROIC POETRY
OF MICHAEL DRAYTON**

(Publication No. 20,146)

Charles Donald Peet, Jr., Ph.D.
Princeton University, 1956

This dissertation is largely a detailed analysis of seven poems by Michael Drayton. These poems include three sets of eclogues and four historical narratives. The eclogues are *The Shepherds Garland* (1593), the revised pastorals of 1606, and *The Muses Elizium* (1630); the historical "epics" are *Mortimeriados* (1596), *The Barons Warres* (1603), *The Battaille of Agincourt* (1627), and *The Miseries of Queene Margarine* (1627). The chief aim of this study is to provide a thorough account of Drayton's

achievement in two significant genres, in the hope that this information will eventually form part of a complete critical study of his career. In addition, the contrast between the stylistic qualities of Drayton's bucolic and epic works sheds some interesting light upon the Elizabethan poet's attitude towards the critical demand for *decorum*. The style of Drayton's works receives more careful study here than their subjects, their sources, or their relation to the poet's personal life. Much of this stylistic analysis centers upon the rhetorical content of the poems. Like most writers of his age, Drayton was profoundly influenced by the theory and techniques of formal rhetoric; the importance of this influence is amply demonstrated in the individual works under study.

Drayton's earliest eclogues and first efforts in the heroic vein reveal that he originally looked upon stylistic brilliance as almost the only important element in poetry. Any fanciful rhetorical device which occurred to him was likely to find its way into his work, regardless of its actual merits. The style of *The Shepherds Garland* is marred by the abuse of a limited number of figures; that of *Mortimeriados* is characterized by figures of amplification, most of which are severely overworked. Both poems suffer from a serious lack of substance.

The revised versions of these works display Drayton's outstanding powers of self-criticism. He gave new thought to the subjects of his verses, introducing a serious theme into several of his eclogues and increasing the historical content of his epic. The rhetoric of his revised pastorals is much less obtrusive than that of the *Garland*. The typical rhetorical devices of *The Barons Warres*, however, while employed with some discrimination, are still as immediately apparent as those of *Mortimeriados*. It appears that Drayton was trying to follow those precepts of *decorum* which called for a distinction between the heroic and bucolic styles by varying the extent to which he concealed his artistry. In both genres, however, he was attempting to write more clearly and correctly than he had before.

His last histories and pastorals reveal a remarkable capacity for growth, unusual indeed in so elderly a writer. The run-on lines of his last two histories are not foreshadowed in any of his earlier works in this genre. The metrical ease and verbal fluency of *The Muses Elizium* are rarely to be found in his earlier eclogues. The self-effacing rhetoric of these last pastorals, however, resembles that of his 1606 volume, while the artistry of his last heroic poems remains rather obtrusive, even though Drayton no longer relies so heavily upon verbal figures for amplification. In *Agincourt*, he realizes his aim by narrating his tale largely through a multitude of short individual scenes; in *Margarite*, he seeks to employ the same method, but the intractability of his subject matter foils his efforts.

The exceptional merits of *The Muses Elizium* testify to the impressive technique with which Drayton's years of conscientious revision had endowed him. The toil he had expended in correcting the faults of his first volumes eventually enabled him to write with complete confidence in his command of his art. He had taught himself to write by writing.

310 pages. \$4.00. Mic 57-2151

THE STYLE OF EDMUND BURKE

(Publication No. 21,352)

Frederick John Rogers, Ph.D.
University of Michigan, 1956

The general purpose of this study is to analyze and evaluate Edmund Burke's prose style. Specifically it seeks to give detailed support to general impressions which perceptive readers have hitherto voiced: of Burke's virtuosity and resourcefulness, of the urgency of his style, of its nobility and grandeur.

Two ten-thousand-word passages from Burke's *Reflections on the Revolution in France*--one at the beginning, the other from a central portion--have been analyzed statistically and scanned for illustrations. In order to provide a basis of comparison, passages of similar length, subject matter, and intention by two other eighteenth-century writers have been similarly examined--one from Hume's *Essays, Moral, Political, and Literary*, the other from Bolingbroke's *Letter on the Idea of a Patriot King*. Chapters II through VI attempt a stylistic description of the *Reflections* passages as they are distinguished from the Hume and Bolingbroke samplings, and from each other, in qualities of diction, in use of parallel structure, in the handling of sentences and paragraphs, in figures of speech, and in occurrence of stress and rhythm. As interesting and significant as the differences of the *Reflections* passages from the other two are the differences between the Burke passages themselves.

In order to discover how Burke's stylistic traits, thus determined, are distributed through his work, Chapter VII then examines samplings of his other tracts and speeches. While it is taken for granted that stylistic deviations are bound to occur in Burke's personal letters and in works mainly expository or narrative such as *The Sublime and Beautiful* and the *Abridgment of English History*, it is shown, on the other hand, that his works of persuasion maintain considerable consistency in the use of expressive forms; the two styles of *Reflections* are often found placed in the same relative positions and devoted to similar purposes.

The study provides considerable support for the idea of Burke's superior resourcefulness in vocabulary, in sentence formation (particularly in the versatile use of parallel structure), and in figures of speech (both in the profusion and clarity of metaphor and in the adaptation of various figures to an ironic tone). The urgency of Burke's writing has several causes. (1) Short sentences are effective in a variety of ways--sometimes in assuming a posture of readiness at the beginning of a paragraph, sometimes in clusters as staccato outbursts of feeling, sometimes as epigrammatic summaries and conclusions. (2) Long sentences are likely to have a firm, well-planned central structure, but a loose and colloquial improvisation in details of syntax. (3) For coherence there is an abnormally low dependence on cluttering sentence connectives and abnormally high dependence on parallel structure, which effects an impelling rhythm. (4) The thought is progressively revealed, with each sentence tending to raise potentialities which the following sentence will continue; the satisfaction of balance and epigram is characteristically saved till the conclusion of a paragraph. (5) The very richness of diction and figure acts itself to arouse attention and expectation. As for the nobility and

grandeur of Burke's style, they result from lofty metaphor and from a high frequency of emotive and ceremonial words, used often in a concentration which avoids bombast through the shock and freshness of their manner of interrelation.

Two styles of Burke are discovered and described: one, the ironic style, used most often at the beginning of his speeches and tracts, and characterized by understatement and flattened emphasis; the other, the better-known impassioned style, used commonly in the central and final portions of his works, and characterized by emotive diction, metaphorical profusion, specially functioning short sentences, and rhythmical and impelling parallel structure. 174 pages. \$2.30. Mic 57-2152

**JAMES GIBBONS HUNEKER:
CRITIC OF THE SEVEN ARTS**

(Publication No. 20,150)

Edgar Smith Rose, Ph.D.
Princeton University, 1955

This is a study of the nature, nurture, and emergence of a uniquely versatile figure in the world of the arts. It covers Huneker's formative years to 1893, by which time, at the age of thirty-six, he had "achieved" a personality and arrived as an impressionist. It is not a portrait *in vacuo*, nor is it a "life and times." An attempt has been made to re-create Huneker's world, the world he knew, and to see him in it. But the focus is upon Huneker himself and his work--specifically upon the three interrelated features that distinguish him: his versatility, his impressionism, and his prose style. The origins of these, both within Huneker and without, are explored and their growth traced.

The first five chapters follow Huneker's progress from cradle to criticism, establishing a true chronology and bringing to light some obfuscations in *Steeplejack*, Huneker's autobiography. Chapter I shows that Huneker was nurtured in a strong family tradition of artistic interest and endeavor. To his father, a jovial amateur in the arts, Huneker largely owed his gusto and freedom from preciosity and affectation. His first literary guide was his mother, a cultivated woman of Catholic convictions. Chapter II deals with Huneker's boyhood and adolescence. From outer compulsion he attended a military academy, apprenticed himself at a locomotive works, and studied law; from inner compulsion he dabbled in magic, practiced the piano, wrote notices for the local paper as a "boy critic," and visited Walt Whitman. Music was his ruling passion; Whitman's poetry, Poe's tales, and Anne Hampton Brewster's *St. Martin's Summer* were permanent influences. Chapter III takes Huneker to Paris where, as in a garden of Adonis, he flourished for ten months. France became his *patrie psychique*, though his letters to the *Evening Bulletin* mingle censure with praise. Chapter IV returns Huneker to Philadelphia for six years of growth and rebellion. From the obscurity of these years emerge his conversion to Wagnerism and his work on the *Etude*. Chapter V tells how Huneker made his way in New York, and re-creates Union Square and environs, his Bohemia from 1886 on.

Huneker's departures from the norm of journalism took two main directions, which are the concern of Chapters VI and VII respectively. One tended toward playful satire, grotesquerie, and the humor of overstatement; the other toward the ornately descriptive and the poetically serious.

Chapter VI develops a contrast between the real world of music trade journalism--in 1888 Huneker joined the staff of the *Musical Courier*--and the fanciful world of Huneker's sketches, peopled largely by "melomaniacs" and other monstrosities. As fantasist and satirist Huneker followed E. T. W. Hoffmann, Berlioz and especially Poe--at a distance. Chapter VI exposes the weakness of Huneker's early fiction, as Chapter VII exhibits the strength of his criticism.

Confirmed in his impressionism by Walter Pater, Oscar Wilde, and Anatole France, Huneker developed a prose style whose sources were (after his own flamboyant personality and musical view of language) the example of Swinburne, and current worship of the Word and overvaluation of the prose poem. Chapter VII discusses Huneker's special variety of impressionism, emphasizing his notions of musical ethos, art and morality, the unity of the arts, and examining his use of synaesthetic metaphor. The chapter opens on Huneker's disillusionment with the New York musical and newspaper worlds--in 1891 he became music critic of the *Recorder*--and closes on his critical triumphs, several of which are excerpted and analyzed.

In addition to the whole body of Huneker's journalistic writings, this study draws upon a mass of unpublished material: several hundred letters, marginalia in his books, various personal documents and manuscripts. The bibliography lists, year by year, all of Huneker's writings that were later collected for republication in book form.

288 pages. \$3.70. Mic 57-2153

**THE RHETORIC OF REBIRTH: A STUDY OF
THE LITERARY THEORY AND CRITICAL PRACTICE
OF KENNETH BURKE**

(Publication No. 21,354)

William Howe Rueckert, Ph.D.
University of Michigan, 1956

This study is primarily a critical, interpretive exposition of the literary theory and critical practice of Kenneth Burke. The purpose of the study is to illuminate both the theory and practice, and to evaluate Burke's contribution to literary criticism (in the strict sense of the word). The method used in the study is a combination of the chronological and logical approach: Burke's books and essays have been dealt with in more or less chronological order, while at the same time a pattern of development which is inherent in the works themselves has been worked out and clarified.

Chapter I of the study deals with Burke's early theories of form, catharsis, and "grace" and tries to show that the theory of literature developed from them was aesthetically grounded and sociologically oriented. According to Burke, art, through form, arouses and gratifies emotions thus effecting a catharsis in the reader and adding "grace" in so far as extra-literary tensions caused by the imperfect

world of overlapping confusions are resolved by this artistic catharsis. Chapter II deals with the extension of the theories of form, catharsis, and "grace" into the theory of symbolic action, and tries to show how Burke's theory of literature becomes sociologically grounded and aesthetically oriented. According to Burke, the essence of all poetry is the psychological function which it performs as symbolic action. All poems are solutions to extra-literary problems; poetry, therefore, performs an unburdening, expiating, and redemptive function for poet and audience. Poetry, in short, is a rhetoric of rebirth which can save us, not from this world, but in this world. Since the function of poetry as symbolic action is so important, Burke believes that the critic should use "all that there is to use" in his studies of this rhetoric of rebirth. The critical method developed for such a study is "dramatism". "Dramatism" as a critical method, especially Burke's use of the scene-act ratio, is examined in Chapter III.

Chapter IV shows how Burke first extends the theory of symbolic action until not just poetry, but all linguistic action is symbolic action, and then, by reducing experience to language, makes language the ultimate reduction. In the course of this reduction, poetry becomes just another linguistic act, rather than a distinct kind of linguistic act, and is treated, not as poetry, but as something else. Burke, as a consequence, is left without any theory of literature qua literature at this stage of his development. Chapter V attempts to show that in the published fragments of A Symbolic of Motives, Burke returns to a consideration of literature as such, and tries to achieve some kind of final balance between the opposed sociological and aesthetic impulses which have characterized all of his thinking about literature.

By way of conclusion, the study maintains that though Burke has never been and will never be an aesthetic purist, he has made major contributions to literary criticism in his theory of form, catharsis and "grace", in his theory of symbolic action, in his literary definitions, in his theories of imitation, tragedy and catharsis, and in his "dramatic" critical method. 238 pages. \$3.10. Mic 57-2154

THE RE-EMERGENCE OF REALISM IN THE MINOR ENGLISH DOMESTIC NOVEL, 1824-1850

(Publication No. 20,897)

Verna Dorothy Wittrock, Ph.D.
University of Illinois, 1957

The purpose of this dissertation is to determine what the early Victorian family novels of lesser rank did to and for realism in the English domestic novel between 1824 and 1850 and for some of the significant realistic domestic

novels of the mid-Victorian period. To discover the nature and extent of the contributions of these minor works, I have considered previous studies on the subject, and I have searched the most important English literary reviews between 1824 and 1850 for reactions to domestic novels. I have also examined letters, memoirs, and biographies by or about the authors of these novels, analyzed the novels themselves, and compared them according to accepted criteria for domesticism and realism with key domestic novels of the years 1847 through 1872. The domestic novel I have defined as one in which the main characters are displayed against a family background throughout a major portion of the book. Realism I have taken to mean truth to the actual settings, characters, incidents, and experiences of the time and place portrayed in the novel.

The domestic novel achieved distinction in realism and artistry between 1811 and 1818 in the stories of Jane Austen, descended into the hands of inferior writers, and fell into an exaggeratedly sentimental, pathetic, and moralizing manner. Though most of the domestic novels between 1832 and 1850 continued to show the serious weaknesses of exaggerated sentiment, pathos, moralization, unusual virtuousness of hero and heroine, unalleviated faultiness of the antagonists, unnatural dialogue, and use of melodrama and coincidence, all of them displayed serious efforts at presenting the realities of contemporary family life. The most conspicuous minor writers of these stories and, therefore, the ones surveyed in this study are Mary Russell Mitford (who did not produce a true novel before 1850 but who did write country sketches that were important in keeping alive and carrying forward the tradition of rural domestic fiction after 1823), Harriet Martineau, William and Mary Howitt, Catherine Gore, Frances Milton Trollope, Mary Martha Sherwood, Harriett Newman Mozley, Elizabeth Missing Sewell, Lady Georgiana Fullerton, Charlotte Mary Yonge, Fredrika Bremer (whose Swedish domestic novels in English translation were popular and influential upon British chroniclers of fictional domestic life), and Anne Marsh-Caldwell.

These minor domestic novelists of the early Victorian period materially aided in the re-emergence of realism in the domestic novel. They sensed and stimulated the taste of the times and produced large numbers of novels with middle-class protagonists. They were more pictorial than previous domesticists in character and plot, took characters and incidents from actuality, attempted two-sided personages, anticipated the later social-psychological novels through inner soliloquies and character analyses, and went beyond Jane Austen in portraying the passions. They broadened and lowered the social range to include the lower-middle and lower classes, and they provided character and plot ideas for the great domestic novelists of the mid-Victorian period--Thackeray, Mrs. Gaskell, Anthony Trollope, and George Eliot.

510 pages. \$6.50. Mic 57-2155

LIBRARY SCIENCE

MESSRS. CAREY & LEA OF PHILADELPHIA,
1822 - 1838

(Publication No. 21,189)

David Edwin Kaser, Ph.D.
University of Michigan, 1956

It is the purpose of this study to examine the history of the Philadelphia publishing firm of Carey & Lea during the seventeen-year period of its existence, 1822-1838. The period is one of transition, during which the modern concept of publishing evolved from the activities of the colonial printer-bookseller. It is the period during which American authors first began to receive patronage; it is the period during which foreign authors were first paid for American publication of their works. Carey & Lea were in the *avant-garde* of every progressive movement in the book trade, so that their history is, in fact, a history of the trade.

The first part of this study concerns the origin of the Carey & Lea firm. Begun in 1785 by Mathew Carey, it was purchased from him in 1822 by his son and son-in-law, Henry C. Carey and Isaac Lea. The contract transferring ownership of the firm was very complex and troubled the principals for over a decade, but the transaction appears to have been most profitable to all three parties.

In the second part of this work, the development of the firm is traced chronologically in considerable detail. Attention is devoted to important works published, reception of works by the public, relations between the firm and its

authors, developments in the book trade affecting publication, and manifestations of growth within the firm itself. The evidence presented here would seem to indicate that by 1830 Carey & Lea were the largest American house. They maintained this supremacy to the dissolution of the partnership eight years later.

The third part of the study concerns the effect that Carey & Lea had upon American literary history and the history of the book trade. The firm was among the first in the nation to take promising authors and develop their reputations to their mutual profit, in the manner of a present-day publisher. This they did for, among others, James Fenimore Cooper, Washington Irving, and John P. Kennedy. Carey & Lea were also among the first American houses to pay foreign authors for their works. Thus in 1827 they paid Sir Walter Scott £295 for advance copy of his *Life of Napoleon*, a sum which was considered at that time to be very high. Carey & Lea published America's first literary annual, establishing a fad that continued almost a half-century. They were the first publishers of the *Encyclopaedia Americana*. They were solely responsible for the establishment of the Book Trade Sales, one of the nineteenth century's outstanding media of book distribution. They also published many books in the fields of medicine, law, science, and technology.

Carey & Lea dominated the Philadelphia book trade at a time when Philadelphia was the publishing center of the nation. Soon after Henry C. Carey's retirement from business in 1838 America's center of literary activity was moved to New York, where it has remained to this day.

293 pages. \$3.80. Mic 57-2156

MATHEMATICS

I: ITERATIVE METHODS FOR THE APPROXIMATE SOLUTION OF LINEAR ALGEBRAIC SYSTEMS.

II: SELF-ADJOINTNESS IN ONE-GROUP MULTI-REGION DIFFUSION PROBLEMS.

(Publication No. 21,185)

Theodore Ware Hildebrandt, Ph.D.
University of Michigan, 1956

Part I introduces and discusses two new methods useful in the iterative solution of linear systems: the "vector δ^2 -process," and the "method of steepest descent for single step," (SDS).

The vector δ^2 -process is a vector analog for the well-known Aitken scalar δ^2 -process, and is defined as follows: Given a sequence $\{u_i\}$ of vectors, the vector δ^2 -process yields a new sequence $\{u_i^*\}$ where

$$u_i^* = u_i - \frac{(\delta u_i)^T (\delta u_i)}{(\delta^2 u_i)^T (\delta u_i)} (\delta u_i),$$

δ and δ^2 denoting the first and second differences, respectively, of the given vector sequence, and the superscript T denoting the transpose. It is shown that the application of the vector δ^2 -process to the total-step (Jacobi) iteration yields the classical method of steepest descent, and that its application to the single-step (Seidel) iteration yields a new iteration analogous to the classical method of steepest descent. Using the notation and definitions of R. Ludwig (Zeit. f. Angew. Math. u. Mech. 34, 404-16) for the order of a vector iteration, the classical steepest descent process serves as a counter-example to show that the vector δ^2 -process does not, like the scalar process, increase the order of every iteration.

Given the system $Au = b$, where the positive definite symmetric matrix A has the form $A = I - B_1 - B_1^T$, B_1 being lower triangular. Then (SDS) has the algorithm

$$u_{i+1} = u_i - \beta_i t_i$$

$$\beta_i = \frac{t_i^T H s_i}{t_i^T H t_i}$$

where H is an arbitrary matrix with positive definite quadratic form ($x \neq 0$ implies $x^T H x \neq 0$), $s_i = u_i - u$, $t_i = (I - B_1)^{-1} A s_i$. The iteration converges to the solution u provided $s_i \neq 0$ implies $t_i^T H s_i \neq 0$. Two choices of H lead to practical methods. $H = A$, and $H = (I - B_1)^{-1} A$, provided that the latter has a positive definite quadratic form. For the choice $H = A$, a rough estimate of the rate of convergence is given. The other choice yields the same method as the application of the vector δ^2 -process to the single-step iteration.

Part II is concerned with the self-adjointness of a linear elliptic differential operator $L(U)$ defined over a bounded connected region S which is subdivided into N subregions S_i by the piecewise smooth surfaces G_{ij} , $i = 1, \dots, N$, $j = 0, 1, \dots, N$. If u_i is continuous with first derivatives continuous in the closure of S_i and second derivatives continuous in the interior of S_i , and satisfies the interface and boundary conditions on G_{ij}

$$\begin{cases} u_i = \alpha_{ij} u_j + \beta_{ij} \frac{\partial u_j}{\partial n_{ij}} \\ \frac{\partial u_i}{\partial n_{ij}} = \gamma_{ij} u_j + \delta_{ij} \frac{\partial u_j}{\partial n_{ij}} \end{cases}$$

$$\phi_{ij} \equiv \alpha_{ij} \delta_{ij} - \beta_{ij} \gamma_{ij} \neq 0, j \neq 0$$

$$= 0, j = 0$$

where n_{ij} is the normal from S_i into S_j , and $\alpha_{ij}, \dots, \delta_{ij}$ are real constants, then the set of functions $\{u_i\}$ are the components of an admissible function U. In each S_i , $L(U)$ is defined by $L_i(u_i) \equiv \nabla^2 u_i + D_i u_i$, D_i being a real function of position continuous in S_i . $L(U)$ is said to be self-adjoint provided there exists a set of N constants k_i such that for any two admissible functions U and V,

$$\sum_{i=1}^N k_i \iiint_{S_i} [v_i L_i(u_i) - u_i L_i(v_i)] d\tau = 0.$$

A sufficient condition that $L(U)$ be self-adjoint is that

$$\phi_{ih} \phi_{hj} \phi_{ji} = 1, \quad \phi_{ij} > 0, \quad \text{all } 0 < i, j, h \leq N.$$

If $L(U)$ is self-adjoint, then it has real eigen-values, and eigen-functions corresponding to distinct eigen-values are orthogonal.

53 pages. \$2.00. Mic 57-2157

GROUP LOGICS AND RESTRICTED IMPLICATION

(Publication No. 21,187)

Walter Hoffman, Ph.D.
University of Michigan, 1956

The rapid development of modern mathematics in recent times can be largely attributed to the use of the axiomatic method. Systems of mathematical logic have also been constructed in an axiomatic way, but somehow or other mathematical logic remains one of the most controversial branches of mathematics, as attested by the large number of different treatments in the literature. For more than a century mathematicians have realized that the term axiom does not represent a self-evident truth, but rather a statement whose truth is merely assumed. Absolute truth does not exist in mathematics or any other science.

This dissertation contains logical systems called group-logics, which are based on a negation of the existence of absolute truth. These systems give rise to a new kind of implication, called restricted implication, which, although closely related to Boolean material implication, avoids the so-called paradoxes of material implication without introducing any new ones.

In chapter I, a brief review of the relevant literature is followed by a discussion of desiderata in a definition of logic. Group-logics are then defined, and some of their general properties are discussed.

Chapter II contains a review of Pólya's counting theorem which is then applied to four examples of two-valued

group-logics. A discussion of implication and some of its paradoxes is followed by the definition of restricted implication in the two-valued case, the properties of which are then demonstrated.

Chapter III begins with a brief discussion of various classical systems of many-valued logics. Examples of many-valued group-logics are then presented, and restricted implication is defined for general group-logics.

Diagrams illustrating the examples of group-logics cited are contained in the appendix.

62 pages. \$2.00. Mic 57-2158

IDENTIFICATION AND ESTIMATION IN TWO STOCHASTIC MODELS

(Publication No. 21,295)

Robert James Lundegard, Ph.D.
Purdue University, 1957

Major Professor: Henry Teicher

In any stochastic model, the primary problem in the estimation of any structural characteristic is the identification of that characteristic. If such a characteristic is identifiable, then the possibility of estimation exists. Two models are introduced: (i) a finite moving average on an independent stochastic process and (ii) a nonlinear bivariate regression model where both variables are subject to error. In submodels of these, the identification of the structural characteristics is established, and the theory of minimum distance estimation is used to establish the existence of estimates which converge almost everywhere to the true structural characteristic.

84 pages. \$2.00. Mic 57-2159

ABELIAN BRANCHED COVERINGS OF KNOTS

(Publication No. 20,137)

John Patterson Mayberry, Ph.D.
Princeton University, 1955

Let K denote a knot in the 3-sphere S^3 , with μ components. Then an abelian unbranched covering of the complement $(S^3 - K)$ is determined by a factor-group of T_μ , the free-abelian group on the symbols t_1, \dots, t_μ , since there is a natural identification of T_μ with $H_1(S^3 - K)$. Thus a map Π of T_μ into some symmetric group \mathcal{S}_n with T_μ^n regular, abelian, and transitive, determines both an unbranched covering of $(S^3 - K)$, and a corresponding branched covering $C(K, \pi)$ [where π is a map determined by Π .]

The main theorem expresses the order $\mathcal{O}(K, \Pi)$ of the first homology-group of $C(K, \pi)$ in terms of:

- a function $\Delta_K(v_1, \dots, v_\mu)$, of μ complex variables, determined by the Alexander polynomials of K and its subknots;
- the set \mathcal{J} of irreducible representations of Π ;
- a real-valued function $D(\Pi)$;

by the formula

$$\mathcal{O}(K, \Pi) = D(\Pi) \cdot \prod_{\mathcal{J} \in \mathcal{J}} |\Delta_K(t_1^{\mathcal{J}}, \dots, t_\mu^{\mathcal{J}})|.$$

The function $D(\Pi)$, given for general Π by a complicated but explicit formula, is evaluated for some special Π , including the cases $\mu = 1$, $\mu = 2$, and the case $t_1^n = t_2^n = \dots = t_\mu^n$.

The result generalizes a result of Fox [B.A.M.S.vol.55 (1949), Abstract 395, p. 704], who considered the case $\mu = 1$, (when $D(\Pi) \equiv 1$ and $\Delta_K = \Delta_K$).

83 pages. \$2.00. Mic 57-2160

ON QUADRUPLY TRANSITIVE GROUPS

(Publication No. 21,492)

Ernest Tilden Parker, Ph.D.
The Ohio State University, 1957

In this dissertation the following theorem is proved: If G is a quadruply transitive permutation group, H is the largest subgroup of G fixing four letters, P is a Sylow p -subgroup of H , P fixes $r \geq 12$ letters and the normalizer in G of P has its transitive constituent A_r or S_r on the letters fixed by P , and P has no transitive constituent of degree $\geq p^3$ and no set of $r(r-1)/2$ similar transitive constituents, then G is alternating or symmetric.

The main result is a corollary to the above theorem. While less general than the theorem, the corollary provides arithmetic restrictions on primes dividing the order of the subgroup fixing four letters of a quadruply transitive group, and on the degrees of Sylow subgroups. The corollary is:

If G is a quadruply transitive permutation group of degree $n = kp + r$, with p prime, $k < p^2$, $k < r(r-1)/2$, $r \geq 12$, and the subgroup of G fixing four letters has a Sylow p -subgroup P of degree kp , and the normalizer in G of P has its transitive constituent A_r or S_r on the letters fixed by P , then G is A_n or S_n .

In the final section it is shown that the only quadruply transitive groups of degrees ≤ 27 are alternating, symmetric, and the four Mathieu groups. All primitive groups of degrees through 20 have been determined. Since there are several primitive groups of most degrees, and the determination of these is lengthy, a systematic search for quadruply transitive groups of low degrees seems desirable.

46 pages. \$2.00. Mic 57-2161

FUNCTIONS OF COMMUTABLE LINEAR TRANSFORMATIONS

(Publication No. 20,945)

Donald Wilford Robinson, Ph.D.
Case Institute of Technology, 1956

A study is made of a defined composition, in a finite linear space over the field of complex numbers, between functions of several complex variables and sets of pairwise commutable linear transformations. The functions

considered are not restricted to be simply power series, nor are the transformations required to be normal, as is the case of previous studies. Equivalent forms of the composition are obtained and some algebraic and topological properties are investigated. The results reveal the composition to be in both form and properties an extension of the previously studied case of a single variable. This is accomplished primarily by the introduction of the concept of projections, corresponding to eigenvalue arrangements, of a set of pairwise commutative linear transformations. Also included are results on rational functions in several commuting linear transformations, enlightening in particular a known result on the eigenvalues of such a transformation. Finally, an extension is made of the class of admissible functions by means of the notion of weak convergence.

46 pages. \$2.00. Mic 57-2162

A GENERALIZATION OF THE PONTRJAGIN SQUARE COHOMOLOGY OPERATION

(Publication No. 20,164)

Paul Emery Thomas, Ph.D.
Princeton University, 1955

Let K be a finite regular cell complex, and let n be an even integer. For each prime number p we define a function \mathcal{P}_p mapping $H^n(K; \text{mod } pm)$ to $H^{pn}(K; \text{mod } p^2m)$ ($m \geq 1$), such that \mathcal{P}_2 is the Pontrjagin square cohomology operation. Each function \mathcal{P}_p is topologically invariant; hence, it is a cohomology operation, which we call the Pontrjagin p^{th} power. Using the complex projective space of $2p$ real dimensions, we construct an example of two complexes which known cohomology invariants fail to distinguish as to homotopy type, but which the operation \mathcal{P}_p does distinguish. The operation \mathcal{P}_p is the n generalized to an operation \mathcal{P}_t ($t = 0, 1, \dots$) such that \mathcal{P}_t maps $H^n(K; \pi)$ to $H^{tn}(K; \Gamma_t(\pi))$, where π is a finitely generated abelian group and $\Gamma_t(\pi)$ is the subgroup of elements of degree $2t$ of the ring $\Gamma(\pi)$ defined by Eilenberg and MacLane [Ann. of Math., vol. 60, pg. 107]. The sequence of operations $\mathcal{P} = [\mathcal{P}_t]_{t=0}^{\infty}$ then satisfies the same set of relations as do the generators of the ring $\Gamma(\pi)$: namely, if $u \in H^n(K; \pi)$, then

- (i) $\mathcal{P}_0(u) = 1$, the unit of the cohomology ring of K with integer coefficients;

$$\mathcal{P}_1(u) = u;$$

- (ii) $\mathcal{P}_r(u) \sim \mathcal{P}_s(u) = \binom{r+s}{r} \mathcal{P}_{r+s}(u)$

- (iii) $\mathcal{P}_t(u+v) = \sum_{r+s=t} \mathcal{P}_r(u) \sim \mathcal{P}_s(v)$
 $u, v \in H^n(K; \pi).$

85 pages. \$2.00. Mic 57-2163

THE ROLE OF THE AXIOM OF CHOICE IN THE DEVELOPMENT OF THE ABSTRACT THEORY OF SETS

(Publication No. 21,133)

William Leonard Zlot, Ph.D.
Columbia University, 1957

I. THE PROBLEM

Statement of the problem. It was the purpose of this study (1) to determine the factors which influenced the axiomatization of Cantor's theory of sets; (2) to discover the origins of the naïve (unaxiomatized) theory of sets; (3) to describe the early attempts to organize the theory of sets into an autonomous discipline; and (4) to describe the influence of the axiom of choice in determining the present form of the theory of sets.

II. THE PURPOSE

Statement of the purpose. The ideas and methods of reasoning of the theory of sets have entered into almost every branch of contemporary mathematics and, therefore, indirectly into all fields that use mathematics. Since the theory of sets is so basic to all of modern mathematics, it was felt that an understanding of the development of this branch of mathematics would aid in the comprehension of the nature of contemporary mathematics as a whole. The axiom of choice was selected as the central theme. The purpose of the study was to show that the recognition of its existence has influenced greatly the evolution of the discipline known as the theory of sets.

III. SUMMARY

The axiom of choice asserts that for each set of non-empty mutually disjoint sets there exists a set (the choice-set) which contains one and only one element from each set. The well-ordering theorem asserts that every set can be ordered in such a way that each subset contains a first element.

The axiomatization of the theory of sets was necessary in order to eliminate certain paradoxes that resulted from Cantor's development. The principal source of these paradoxes was Cantor's definition of a set. Under axiomatic treatment the word set is undefined. The axioms give an implicit definition to the notion of a set.

Cantor's creation of the theory of sets was motivated by certain researches in the theory of trigonometric series. His development of the theory of sets was based upon the notion of a derived set, and he eventually conceived of an infinity of them. Cantor was then able to extend the series of natural or counting numbers to include infinite numbers. His researches led him to the notion of power or cardinal number and ultimately to an infinite series of these powers. The unity of Cantor's extension of number to include infinite numbers was fundamentally based upon the well-ordering theorem — a theorem which he did not prove.

Zermelo's use of the axiom of choice in his proof of the well-ordering theorem aroused much discussion and helped foster the development of the school of mathematicians known as the Intuitionists. The very nature of mathematics itself and the notion of existence in mathematical science

came under close scrutiny and attack. Many of the underlying problems of the foundations of contemporary mathematics were brought to light as a result of the controversies.

In 1908, Zermelo (1871-) gave the first axiomatization of the theory of sets. The main features of his axiomatization are found in all contemporary axiom

systems of set theory. The assumption of the axiom of choice is necessary in order to prove the logical equivalence of several apparently equivalent definitions of finite sets. The axiom of choice must also be assumed if set theory is to be visualized as a generalized theory of numbers. 208 pages. \$2.70. Mic 57-2164

MINERALOGY

POLYTYPOISM OF CADMIUM IODIDE AND ITS RELATIONSHIP TO SCREW DISLOCATIONS

(Publication No. 21,340)

Richard Scott Mitchell, Ph.D.
University of Michigan, 1956

The purpose of this study is (a) to report the numerous structural types of cadmium iodide that have been discovered by the writer, and (b) to show how the screw dislocation theory of crystal growth supplies a satisfactory mechanism for generating these structures. A definition of polytypism that can be applied to all types of substances has been formulated.

Part I is concerned with a systematic description of the different cadmium iodide polytypes. Complete structural data are given for the ten types designated by 2H, 4H, 6H_(a), 6H_(b), 8H, 10H, 12H_(a), 12H_(b), 12H_(c) and 14H. Twenty-two other polytypes ranging from 16H to 64H are also reported, but their structures are still unknown. It was found that nearly 50% of the crystals studied had the 4H structure, while the remaining ones had rare or disordered structures. A definite series of related cadmium iodide structures was discovered that has a Ramsdell zig-zag sequence represented by '22...11'. This structural series is analogous to the structural series known to exist for some time in silicon carbide.

The explanation of polytypism in cadmium iodide is given in Part II. After a general survey of the former

explanations of polytypism, an outline of the theory that the different structures result from the spiral growth of crystals as a result of screw dislocations is given. It was found that all the structures of the '22...11' series could be generated by spiral growth from single nonintegral screw dislocations in an 'ideal' 4H structure. All of the other known structures not belonging to this series could be accounted for in a similar manner by assuming the presence of two or more cooperating dislocations and/or an alternate arrangement of the initial ions as they take their places at the bottom of a growing step. Structural series like '22...1111', '22...33' and '22...2123' are to be expected as a result of these considerations. The proposed causes of dislocations are outlined and then it is shown how they are related to the former explanations of polytypism. Other polytypic substances such as silicon carbide and graphite are considered in the light of these findings. It is pointed out that polytypism is not to be expected in certain substances because of the nature of their 'ideal' structures.

In conclusion it seems certain that polytypism in cadmium iodide, and perhaps in every substance, is a result of the spiral growth of crystals, resulting from screw dislocations of various kinds in an 'ideal' structure. In addition to explaining polytypism, this work also validates the more general theory that certain crystals grow in a spiral fashion. 93 pages. \$2.00. Mic 57-2165

MUSIC

SECOND SYMPHONY

(Publication No. 21,142)

Leslie Raymond Bassett, A.Mus.D.
University of Michigan, 1956

The Second Symphony is a four movement work scored for piccolo, two flutes, two oboes, English horn, two Bb clarinets, bass clarinet, two bassoons, contra-bassoon, four horns in F, three trumpets in Bb, three trombones, tuba, timpani, two percussion parts, and a full complement of strings.

The first movement, an energetic and moderately fast sonata-allegro, opens in the low strings and grows to a full orchestral statement centered in the brass. The

second thematic area, scored primarily for strings, follows a brief passage in a somewhat slower tempo. Woodwind solos form a transition between exposition and development, which returns to the initial tempo. Thematic material is now considerably altered and expanded as the development unfolds, and finally closes with longer woodwind solos. The recapitulation closely resembles the exposition thematically and formally. A short coda ends the movement quietly.

The second movement - a fast, scherzo-like ternary design - evolves from a conflict between simple and compound meters. It opens with an alternation of dramatic and lyric materials. As the movement proceeds, the simple meter triumphs over the compound. A middle section in 4/4 meter follows. The conflict then returns, with

its contrasts of twos and threes; and after several violent outbursts the piece ends quietly.

The third movement is a through-composed composition, slow and expressive in nature, that rises to several central climaxes through successive phrases of increasing intensity and sonority. The descent to the end of the movement, although shorter in length than the ascent, leads to an ending similar in mood to the opening.

The finale begins and ends with a brilliant, fully scored passage that gives prominence to the brasses. The movement is intended to give the feeling of rondo form, although the "repetitions" are of mood and general style rather than of specific thematic material. The central portion of the movement gradually becomes more lyrical and less active rhythmically. A long crescendo leads back to a restatement of the opening material, which brings the symphony to a close.

The tonality of the symphony is A. Each movement contributes, although not obviously, to the establishment of that tonal center. The first movement is in C, the second in D, the third in C#, and the fourth in A.

The score relies heavily upon full orchestral sonority rather than solo instrumental sounds. The composer means the work to have much resonance and dramatic impact.

152 pages. \$2.00. Mic 57-2166

THE SYMPHONIES OF JOHANN VANHAL (VOLUMES I AND II)

(Publication No. 21,134)

Paul Robey Bryan, Jr., Ph.D.
University of Michigan, 1956

Present-day knowledge of eighteenth-century music is based largely on studies of the music of Haydn and Mozart. True understanding of the period will result from the inclusion of investigations of secondary composers, with an estimate of their importance and a study of their works. The problems of such a study are: (a) lack of sufficient biographical material, (b) authenticity and dating of the works, (c) locating and obtaining the works, (d) establishing criteria for a style study.

Johann Vanhal (1739-1813) a Viennese composer, was born in Bohemia. His musical productivity divides into two periods: during the earlier (ca. 1765-85) he wrote larger instrumental works including symphonies, concertos, etc.; and later, smaller pieces for the pleasure and instruction of amateur performers. In the latter period he also composed a large quantity of music for the church. The earlier symphonies were especially popular about 1772, and he attained a leading position which probably lasted about a decade.

The authenticity and dating of all Vanhal symphonies are open to question due to the lack of holograph copies or any other direct connection with Vanhal, as well as the prevalence of pirating practices of publishers and copyists in the eighteenth century. Breitkopf's thematic Catalogues provide the best source of information. Additional data have been obtained from other catalogues, from the published editions, and from notations on manuscript parts. Copies of several of the symphonies attributed to Vanhal have been found which bear the names of other composers, chiefly Joseph Haydn.

A style study was made of seventeen of the early symphonies, which represent Vanhal's most important period as symphonic composer. The study deals with the following technical aspects of the music: melodic materials, the temporal element, harmonic materials, cadences, orchestration, and dynamics, with the observable trend in their use. Particular attention is given to the melodic element, the most important feature of the music in this period of the eighteenth century. The great predominance of sonata form in first, second, and last movements and the wide variation in treatment of thematic material offer evidence that these works illustrate a phase in the development of sonata form. Melodic material is classified according to its function in different areas of the form. The trend in Vanhal's writing, especially in first and last movements, is from short thematic ideas in the earlier works, toward longer, full-size themes in the later ones. The result of this expansion of melodic areas is an increase in length which ranges from the 80 measures of the first movement in one of the earliest works to the 242 measures of one of the later ones. Further study of melodic characteristics deals with detailed components and presents certain aspects which might be said to represent Vanhal's personal traits.

The aid of Dr. Jens Peter Larsen, Mr. H. C. Robbins Landon, and Miss Inger Christensen has been of inestimable value in the collection of information about all of the 105 symphonies attributed to Vanhal. The thematic incipit of the first movement of each work is given, as well as the following data, when available: estimated earliest date, instrumentation, movements, authenticity, variations in editions, references in contemporary catalogues, publishers, and present location of manuscript copies. A compilation of data for more than ninety printed editions by nineteen publishers includes estimated dates and sources for dating information and known locations. Scores of six works, representative of the seventeen symphonies included in the style study, are reproduced in score form.

527 pages. \$6.70. Mic 57-2167

ALBERTO DA RIPA: LUTENIST AND COMPOSER (VOLUMES I AND II)

(Publication No. 21,154)

Robert William Buggert, Ph.D.
University of Michigan, 1956

The purpose of this study is threefold: 1) to make available a modern edition of the works of Alberto da Ripa, 2) to collect and clarify the facts concerning his life and his music, and 3) to present an analysis of his musical style with an evaluation of his contribution to music of the Renaissance period.

As is indicated in the biographical data (Chapter I), Alberto da Ripa was born in Mantua, Italy in the late fifteenth century and died in 1551. Little is known of his early life; the bulk of information concerns Alberto's activities as a musician in the courts of Francis I and Henry II at Paris where he was lutenist, composer, and *valet de chambre* from 1529 until his death. In addition to being a virtuoso performer he composed more than twenty-one fantasies for the lute. His technique as a composer is also

reflected in the many intavolatura present in his tablature books. Publication dates, which range from 1536 to 1564, sources, and present locations of these books as well as microfilm copies are given (Chapter II).

A discussion of the symbolization and characteristics of both French and Italian lute tablature follows with special attention given to the solutions of transcription problems evident in the tablature books of Da Ripa. The basic problem is that of deciding upon a literal or a polyphonic method of transcription. This thesis, advocating a polyphonic realization, considers the following factors in the process of making prudent transcriptions: 1) evidences of contrapuntal texture, 2) duration of individual tones, 3) establishment of valid voice lines, 4) realization of apparent imitation, and 5) a step-by-step process for the transcription of lute tablature. The solutions of these problems are clarified by the inclusion of examples.

The fantasies, after being transcribed, are analyzed in relation to melodic, rhythmic, harmonic, and contrapuntal characteristics. The following is a terse summary of qualities characteristic of Da Ripa's fantasies: 1) average length, 2) well defined thematic material, 3) typical sixteenth-century thematic material, 4) unified, interesting, and dynamic rhythm, 5) generally functional harmony, 6) harmonically derived contrapuntal devices, 7) opaque texture, 8) through composed, 9) irregular sectionalization, and 10) dynamic movement until the final cadence. The analysis is augmented by charts showing imitated thematic material, sectionalization, and specific interesting features.

The characteristics of the intavolatura are given with attention to comparisons with vocal originals. The man, his position, and compositions are evaluated in relation to the period. A thematic index of compositions and an index of intavolatura sources are given.

Volume II is a modern edition of the works of Alberto da Ripa transcribed from six available lute tablature books.

Three general conclusions are drawn from this study. 1) Alberto da Ripa was a prominent, learned man respected by his associates. 2) His fame as a lutenist makes him a conspicuous personality in the performance of sixteenth-century instrumental music. 3) The charm and excellence of his compositions identify him as one who has made a significant contribution to the repertoire of Renaissance lute music. 443 pages. \$5.65. Mic 57-2168

**GIOVANNI GABRIELI'S SACRAE SYMPHONIAE (1597)
(VOLUMES I AND II)**

(Publication No. 21,136)

John Arnold Flower, Ph.D.
University of Michigan, 1956

Giovanni Gabrieli stood at the forefront of Venetian polychoral composers during the late sixteenth and early seventeenth centuries. His compositions exerted an influence which has long been recognized by scholars. However, information about the man and his music, and modern reprints of his works have remained scanty. The purpose of the dissertation is thus twofold: (1) to present an analytical study of the *Sacrae Symphoniae* (1597); (2) to

present in modern score twenty six of the forty seven motets from the *Sacrae Symphoniae*.

Volume I of the study contains a discussion of Gabrieli's motets under the following general headings: (a) forms; (b) textures; (c) harmony; (d) melody; (e) rhythm.

Volume II contains transcriptions in modern notation of the first twenty six motets in the collection, scored for one and two choirs, in six, seven, and eight parts.

Gabrieli's forms were found to include principles embodying through-composition, extensive repetition, and a clearly defined use of the ritornello. His textures, deriving in part from a wide variety of voice distributions, and from diversified antiphonal combinations, were found to play an important part in the delineation of the actual formal structures. This was quite apart from considerations of harmony, melody, and rhythm. His use of harmony extended in a line of development from horizontally conceived motets, in which the chord types and chord progressions derived from the confluence of several voice parts, to homophonically conceived motets in which the chord relationships presaged the major-minor system codified by later generations. Gabrieli's melody construction, also, derived from sixteenth-century practice, but adjusted itself to the increasing importance accorded homophony, wherein the successive interval relations and general linear contour are adapted to harmony rather than polyphony. Rhythm containing a regularly recurrent pulse as compared to non-metered, freely-imposed accent, was found to predominate in the *Sacrae Symphoniae*. The reason for this may be found in the general development toward homophonic, away from polyphonic textures.

Two basic conclusions emerge from the study. (1) Gabrieli's widely divergent textures, and his correlation of these textures into antiphonal combinations, greatly expanded the formal types available to composers for large choral groups. (2) The development of his chord progression, characterized by consistent root movement of the fifth, imparted a feeling toward levels of tonality which anticipated the tonal evolution that crystallized during the seventeenth century. 370 pages. \$4.75. Mic 57-2169

**AUGUST WILHELM AMBROS:
HIS HISTORICAL AND CRITICAL THOUGHT
(VOLUMES I AND II)**

(Publication No. 20,143)

Philipp Otto Naegele, Ph.D.
Princeton University, 1955

The three chapters of "August Wilhelm Ambros — His Critical and Historical Thought," are devoted (1) to the author's life and literary endeavor, (2) to the sources of his intellectual orientation in certain currents of thought in nineteenth century Germany, and (3) to an "abstract" of the entire history of music in which are brought together the most important ideas, descriptions, and observations from all his available writings.

The study points out Ambros' attractive qualities as a person and as a brilliant figure on a musical scene marked as much by its literary as by its musical output. Extensive quotations in translation serve to introduce the reader to Ambros' literary style — a style, which admittedly, disappoints itself less elegantly in our translation.

(1) Ambros' life (1816-1876) is characterized by a bewildering variety of activities, by divided professional allegiances and a voracious intellectual curiosity responsible both for the readability and the incompleteness of his work. By parental decree and practical necessity forced into the study of law and into public service, Ambros succeeded in devoting himself to his passion for the arts only after a long struggle. First as music critic in Prague, then as composer and as essayist writing on the principal questions of contemporary music (i.e. Mendelssohn, Schumann, Berlioz, Wagner, etc.), and finally as a historian of music, he gradually left behind him the oppressive boredom of bureaucratic labor. Through extensive travels in Italy and his removal to Vienna in 1871, he expanded his vision from the (to him) somber walls and turrets of Prague to the glories of Venice, Florence, Rome, and Vienna. As a young man the center of an ardent Prague branch of Schumann's, "Davidsbund," "Flamin" became in time the friend and correspondent of great musical personalities, scholars, and artists, a polemicist of quality, a professor and scholar, a teacher in the imperial employ, and finally the posthumous recipient of a title of nobility.

Ambros, the head of a large and happy family, a devout Catholic, was a man of great exuberance and joy, and an enthusiastic, almost religious devotee of the arts. But he was oppressed by certain political, intellectual, and artistic developments of his time — notably after 1848 — which led him to gloomy prophecies on the future of art and of christian society under the impact of materialism, the modern 'mass,' and the intellectualization of artistic creativity. Thus his work was never scholarship for its own sake, but an attempt to aid in the preservation of the best in European culture through the knowledge and restoration of the musical monuments of the past, and through a critical appraisal of the present so as to reconcile tradition and modernity.

(2) The sources of Ambros' ideas are manifold and contradictory, leading to a "conflict between philosophy and history." Indebted to Hegelian idealism, according to which art is a visible form of the divine and of the Universal Idea through which the world in one great teleological process develops toward its imminent goal of self-comprehension and perfection, he owes as much to the nineteenth century discovery of the variety in human history and the "equality before God" of all cultures, regardless of any postulated "progress," "purpose," or "goals." To the former he owes his preoccupation with music as a specifically "modern" art (as opposed to architecture and sculpture), best suited to be a vehicle of christian self-consciousness. His debt to the German historians — notably the "historische Schule" of the turn of the century — to the literary romantics, and to his predecessors in art and music history, lies in the imaginative penetration of the past and in an attempt to write the first universal music history modeled on the best endeavor in other historical disciplines. With both traditions he shares the emphasis on the past and on its presence in the contemporary consciousness. Thus the study of history becomes a means of self-comprehension, a guide in a time which had discovered itself incapable of moving "blindly" forward, free from reflective self-appraisal, doubt, self-justification — a time oppressed by the pessimism of a Jakob Burckhardt or Ernst von Lasaulx, by doubt in an inherited faith in progress.

(3) Ambros, the scholar of the Renaissance and

antagonist of all historiography singling out the present or any other period as the height of perfection and goal of history, nevertheless, by virtue of his Hegelian orientation, submitted his historical view to a teleological scheme. Since Universal history was the drama in whose course the Idea behind the world realizes itself in the world, and comes to self-knowledge through man's growing consciousness, the history of the arts, music included, has the same import. The arts are expressions of their times, however, the individual arts, though existing always side by side, come into special prominence as carriers of the Idea in different periods of history, the sequence being architecture, sculpture, painting, music, and poetry. Music as an expression of the higher experiences of self-consciousness, as an expression of the soul and intellect, develops late and is confined to the occidental-christian world. Only in christian Europe are the Greek traditions of formal beauty and the Judaic traditions of 'musica sacra' united to ultimately establish an independent musical art capable of expressing the entirety of spiritual experience.

Like the Hegelian "system of the arts," the development of music proceeds from the architectural to the poetic side. After lagging behind the other arts due to its "youth," music in the time of Dufay attained mastery enough to suffuse the formalism of polyphony with the beauty of sacred and secular monophony. After this "music of form," the road led to the "music of the soul," i.e., Renaissance through the later eighteenth century. Beethoven ushered in the "music of the spirit" and with it the complete musical emancipation of the individual and the ultimate fulfillment of the idea of Renaissance. However, the growth in musical articulateness led onward to the "music of the intellect" where, in opposition to the early predominance of form, expression of intellectual and literary content obscured the natural "boundaries of music and poetry" (Berlioz, Liszt, Wagner). Ambros sensed the encroachment of modern preoccupation with man, with materialistic science, as the root evil undermining artistic creativity in its old sense of a union of craftsmanship and inspiration. He looked with grave doubt into the future, but also with the confidence that the crisis might pass, since God would not conceivably reserve his gifts for one era at the expense of the following. 495 pages. \$6.30. Mic 57-2170

TONAL ORGANIZATION IN THE SONATA MOVEMENTS OF HAYDN'S STRING QUARTETS

(Publication No. 21,344)

Lewis Vincent Pankaskie, Ph.D.
University of Michigan, 1956

Haydn's treatment of tonality has attracted special attention in every serious estimate of his work. The more usual comments deal with the relationship amongst the keys of the several movements of a work, with occasional reference to an astonishing modulation in the course of a movement. Such comment does, indeed, focus the attention upon a fascinating feature of Haydn's style; but it is not possible to comprehend Haydn's concept of tonality from this evidence alone.

The purpose of this study is to accumulate a large body of evidence from which it is possible to gain a

comprehensive view of Haydn's tonal practice. It was necessary to select a substantial number of complete movements in which tonality is a crucial feature. The classic sonata movement is a peculiar revelation of tonality. In the sonata movements of his string quartets, Haydn reveals an expansive system of key relations, and his treatment covers a wide range, from firm restraint to utmost freedom.

The study makes no historical inquiry into the antecedents of Haydn's style. The first chapter presents a brief review of the basic principles of sonata form established before Haydn's earliest work, together with a summary of currently prevailing theoretical concepts. The main body of the study is entirely devoted to analytical description of Haydn's tonal concept and method.

The analysis begins with a preview of the general outlines of sonata form. The antecedents of Haydn's form are clearly evident in the Prussian and Württemberg sonatas of Carl Philipp Emanuel Bach. An analysis of these works provides a useful introduction to the outlines of sonata form in Haydn's quartets. The next three chapters offer a detailed analysis of Haydn's tonal procedure in each of the three main parts of the exposition: the tonic key, the modulation, and the related key. Haydn's penchant for tonal elaboration is evident in every part of the exposition, especially in the related key. One chapter is devoted to the organization of the development. In this section Haydn exploits his tonal system to the fullest. In his choice of keys he ranges from casual relation to intense conflict; in his treatment of modulation he ranges from light finesse to dramatic intrigue. The basic strategy of development is the return from the related key of the exposition to the tonic key of the recapitulation. Haydn alternates direct progression and clear anticipation with evasion and equivocation, to produce not only an excursive order of keys, but to create a plot in which deception and complicity are often the primary features. The analysis is concluded with a study of Haydn's treatment of the recapitulation. This final section of the movement provides a climactic emphasis of the tonic key, and serves to summarize, and occasionally to amplify, the preceding sections of the movement.

A concluding chapter summarizes Haydn's concept and treatment of tonality in the sonata movement. Most of the components of his tonal system, and all of the basic principles of tonal organization are clearly evident in the earliest quartets. In a subsequent half-century of creative effort Haydn develops techniques that are sometimes sly and playful, sometimes mystifying and suspenseful, always engaging, and always in accord with refined classical logic.

341 pages. \$4.40. Mic 57-2171

A COMPARATIVE STUDY OF FIVE
MUSICAL SETTINGS OF LA CLEMENZA DI TITO
(VOLUMES I AND II)

(Publication No. 21,371)

William Jesset Weichlein, Ph.D.
University of Michigan, 1956

The full history of opera seria in the eighteenth century has yet to be written. What meager contributions

have been made are quite inadequate. In most histories of music and other works which discuss the Italian serious opera of the eighteenth century, it is spoken of and dismissed as "stereotyped," "stylized," "over-exaggerated," "outmoded," and many other equally general terms.

Existing modern critical editions of the music are relatively few, and yet this was the type of opera which may be very frequently found in the works of Handel, Caldara, Hasse, Jommelli, Trajetta, Gluck, and many other noteworthy composers of the eighteenth century. This was the opera which dominated all of the countries of Europe, except France, for almost one hundred years, and this was the opera which is best represented in the librettos of one of the best known Italian playwrights of all time, Pietro Metastasio. Certainly a form which commanded this much respect during its lifetime deserves an objective investigation and evaluation in the light of eighteenth-century opera aesthetics, even if it is a type which seems to have aroused a special antipathy in historians of the Victorian Age and the early years of the present century.

This study attempts to explore the development of the Italian serious opera through an investigation of the approaches of a number of prominent eighteenth-century composers to the same libretto of Metastasio, *La clemenza di Tito*. Although the composers who have been selected (Caldara, Hasse, Gluck, Galuppi, and Mozart), represent only a few of the many who set this libretto, they constitute a group whose talents are universally respected today despite the passing of almost two centuries.

The opening chapter deals with Metastasio's place in the history of the Italian tragedy and the second chapter deals specifically with his librettos, and attempts to place *La clemenza di Tito* in a proper perspective with regard to the works which preceded it. Chapter III deals with alterations made in the libretto for the various musical settings under discussion. Chapter IV comprises the main body of the text as it deals with the music of the five different settings. Here the musical work of each composer is analyzed in terms of the principal components of opera: recitative, aria, vocal ensemble, and independent instrumental music.

The final chapter, in a summation of findings and conclusions, points out that although the composers always seemed to remain content with the basic form of the Metastasian libretto, they consistently sought to reduce the amount of superfluous dialogue. No matter how much dialogue was omitted, however, the original number of arias never varied greatly.

The composers of the period under discussion generally seemed to be more concerned with the creating of a musically interesting work than in adhering to any set formula of construction. The various progressive trends noted in the music show a certain change in the attitude of composers toward the opera seria, but in view of the tremendous changes which were effected in other musical media throughout the second half of the eighteenth century, there is surprisingly little change proportionately in these operas.

A second volume contains the various appendices referred to throughout the text, a copy of the libretto, and a listing of the known settings of Metastasian librettos by eighteenth-century composers.

520 pages. \$6.60. Mic 57-2172

PHARMACOLOGY

CELL MEMBRANE REPOLARIZATION AND CONTRACTILE TENSION IN RABBIT ATRIUM

(Publication No. 21,199)

Peter Paul Cervoni, Ph.D.
University of Washington, 1957

Isolated atria from rabbits were studied. Transmembrane potentials were recorded by the microelectrode technique. Contractile tension was observed with the aid of a strain gauge transducer. Electrical and mechanical events were displayed simultaneously on the screen of a dual beam cathode ray oscillograph. The phenomena of post-stimulation and post-quiescent potentiation were observed. Primary attention was attached to the first post-stimulation or post-quiescent contraction (rest contraction), comparing changes in tension and action potential configuration with control contractions. Changes in tension and repolarization were a function of stimulation frequency in the post-stimulation phenomenon, and of the rest interval in the post-quiescent potentiation. Qualitatively, the responses were similar in the two phenomena but absolute values were different: tension changes being greater for post-stimulation potentiation, while repolarization changes were more marked for post-quiescent potentiation. Typical repolarization changes were as follows: (a) accelerated initial phase of repolarization (Phase 1) and (b) slowed secondary phase of repolarization (Phase 2 and action potential duration). Analysis of the data indicated that changes in contractile tension were closely correlated with changes in Phase 2 or with duration of the total action potential. Change in Phase 1 or the initial phase of repolarization is correlated with tension within each method.

The effects of acetylcholine and epinephrine on these potentiative phenomena were studied. Acetylcholine while decreasing absolute tension and accelerating repolarization had the following effects on the potentiated beat in the post-stimulation method: (a) augmented potentiation, (b) greater membrane potential at which point of maximum curvature in repolarization occurred, and (c) slowed repolarization and increased Phase 2 plateau. Its effect in post-quiescent potentiation was as follows: (a) no effect on potentiation of tension, (b) greater membrane potential at which point of maximum curvature in repolarization occurred, and (c) increased duration of action potential and Phase 2 plateau. 1-Epinephrine had the following effects on the post-quiescent potentiation phenomenon: (a) no effect on potentiation of contraction although absolute tension of control contractions increased slightly, (b) sharpened the point of maximum curvature between Phases 1 and 2 of repolarization, and (c) increased Phase 2 and action potential duration. 100 pages. \$2.00. Mic 57-2173

ANESTHETIC AGENTS IN HEMORRHAGIC SHOCK

(Publication No. 21,329)

Bert K. B. Lum, Ph.D.
University of Michigan, 1956

The influence of anesthetic agents in shock has been studied by many investigators in recent years. The results of these investigations, however, have been diversified and conflicting, anesthetic agents being reported as having deleterious, beneficial or no effects on the course of the syndrome. The purpose of this investigation is to study and define more clearly the effects of anesthetic agents on the course of experimental hemorrhagic shock.

Shock was induced by bleeding dogs to an arterial pressure of 45 mm. Hg. and then maintaining this hypotensive level for a period of time. Four dogs were simultaneously studied in each experiment. One animal served as an unanesthetized control; operative procedures in this dog were made under local ethyl chloride anesthesia. A second dog received 3 to 4 mg./kg. of morphine sulfate subcutaneously. Operative procedures in the morphinized dog were made under local procaine anesthesia. The third animal was anesthetized with sodium pentobarbital, 25 to 30 mg./kg. intravenously, while the fourth dog received a combination of 100 mg./kg. chloralose and 350 mg./kg. urethane intravenously. The period of controlled hypotension in each experiment was terminated by reinfusion of the withdrawn blood when it was estimated that at least one dog was in an irreversible state of shock and at least one dog was reversible to blood replacement. Following the shock-inducing procedure, the animals were surgically repaired and returned to their dog pen for further observation. Animals which lived 96 or more hours after blood replacement were considered as survivors.

Our results clearly show that anesthetic agents administered prior to hemorrhage significantly delay the onset of irreversible shock. Thirteen of twenty pentobarbital ($P < 0.001$), twelve of twenty morphine ($P < 0.001$), and eight of twenty chloralose-urethane ($P < 0.05$) animals survived the hemorrhagic shock-inducing procedure as compared with one of twenty control unanesthetized animals.

A significant difference in the rectal temperatures of the anesthetized and unanesthetized animals, which may partially explain the difference in survival rates, was demonstrated. While a number of differences in the rate and magnitude of bleeding of the anesthetized and unanesthetized animals were noted, the protective action of anesthetic agents in shock did not appear to be causally related to these differences. Other possible mechanisms by which anesthetic agents may exert a protective action in shock are discussed. 88 pages. \$2.00. Mic 57-2174

THE MECHANISM OF TOXICITY OF SYMMETRICALLY SUBSTITUTED DITHIOOXAMIDES

(Publication No. 21,338)

James Gregory Miller, Ph.D.
University of Michigan, 1956

The objective of this research was to elucidate the mechanism of toxicity of substituted dithiooxamides in terms of altered biochemical activity.

The toxicity of dithiooxamide, N,N'-bis(2-hydroxyethyl)dithiooxamide, N,N'-di-secondary butyldithiooxamide and N,N'-diallyldithiooxamide was studied. N,N'-di-secondary butyldithiooxamide and N,N'-diallyldithiooxamide were shown to be the toxic members of the series. Their toxicity is characterized by a latent period at low dosages, ventricular fibrillation in dogs, cats, and rabbits, and central nervous system disturbances in all species. N,N'-di-secondary butyldithiooxamide exhibited an extreme cumulative toxicity in rabbits.

Homogenate and mitochondrial preparations of rat brain and liver were used to study the biochemical aspects of dithiooxamide toxicity. Purified preparations of liver alcohol dehydrogenase and glucose-6-phosphate dehydrogenase were also utilized. The study of these enzyme systems was also supplemented by the determination of coenzyme I levels in the liver of treated rats.

The toxic members of the series inhibited all coenzyme I-linked apoenzymes in both mitochondrial and purified preparations. The relatively nontoxic compounds did not exhibit any *in vitro* action. The inhibition of coenzyme I-linked mitochondrial systems was competitive in nature and could be reversed by the addition of coenzyme I.

The coenzyme I content was markedly reduced in the liver of rats that had received an LD₅₀ dose of N,N'-di-secondary butyldithiooxamide. The initial reduction consisted entirely of a decrease in the oxidized coenzyme I. This resulted in a reversal of the normal ratio of oxidized to reduced coenzyme I. Seventy-two hours after the administration of the compound, the content of reduced coenzyme I was decreased, restoring within normal limits the ratio of oxidized to reduced forms. The content of total coenzyme I was still very low.

The conclusion is drawn that coenzyme I is a pertinent characteristic of apoenzymes inhibited *in vitro* by the potent dithiooxamides. The altered levels of coenzyme I in treated animals indicate that this is probably an *in vivo* site of action of the compounds. The mechanism of toxicity of symmetrically substituted dithiooxamides is the occupation of coenzyme I sites of apoenzymes.

88 pages. \$2.00. Mic 57-2175

A STUDY OF THE IRRITANT EFFECTS OF SEVERAL INORGANIC SALTS IN COMBINATION WITH CERTAIN SODIUM ALKYL SULFATES

(Publication No. 21,312)

Robert Joseph Schlembach, Ph.D.
Purdue University, 1957

Major Professor: Dr. T. S. Miya

The investigation demonstrated that the combination of several inorganic salts with certain sodium alkyl sulfates produced a greater irritation on both rabbit and human skin than did the sodium alkyl sulfates alone.

The inorganic salts (calcium chloride, magnesium sulfate, sodium bicarbonate, sodium nitrate, sodium chloride, trisodium phosphate, and sodium sulfate), 0.002N, were tested with sodium alkyl sulfates (sodium octyl, decyl, lauryl, myristyl, cetyl and stearyl sulfates), 0.0225N, by a modified patch test. A numerical evaluation based upon degrees of erythema and edema was employed for comparison.

Among the detergent bases, sodium lauryl sulfate produced the highest irritation scores on rabbit and human skin.

Among the combinations of the inorganic salts with the sodium alkyl sulfates, those which involved sodium lauryl sulfates produced the highest irritation scores on rabbit and human skin.

Among the inorganic salts, trisodium phosphate, alone and in combination with the sodium alkyl sulfates, exhibited the highest irritation scores on rabbit and human skin.

A suggestion that the increased irritation might be due to an increased concentration of undissociated sodium alkyl sulfates through the presence of a common ion (sodium) was substantiated by the enhancement of primary irritation when the trisodium salt was employed.

85 pages. \$2.00. Mic 57-2176

GLUTAMIC ACID DECARBOXYLASE AND 4-AMINOBUTYRIC ACID IN SOME BIOLOGICAL SYSTEMS

(Publication No. 21,314)

Roger Powell Smith, Ph.D.
Purdue University, 1956

Major Professors: Gustav Cwalina and Egil Ramstad

The purpose of this work was to screen some common alkaloid-producing plants manometrically for certain amino acid decarboxylase activity and, if such activity were found to be present, to establish if a formation of the corresponding primary amines could be the initial step on the route to the biosynthesis of alkaloids. It was hoped that this work could establish alkaloids as detoxification products in any particular plant. The plants studied included *Datura stramonium*, *Papaver somniferum*, *Ricinus communis* and *Delphinium ajacis*. The amino acids suspected as being alkaloid precursors and used as substrates were tryptophan, phenylalanine, tyrosine and dopa. No

decarboxylase activity for the indicated substrates was observed, but the presence of glutamic acid decarboxylase was established during routine screening of *P. somniferum*.

Because of a lack of time and funds, the original project was abandoned in favor of a study of glutamic acid decarboxylase and 4-aminobutyric acid in several different biological systems. This enzyme was also found to be present in *R. communis*, and free 4-aminobutyric acid was found in *D. stramonium* and *Delphinium ajacis*.

In acorn squash homogenates the decarboxylation of glutamic acid under anaerobic conditions as determined manometrically was found to exceed the activity under aerobic conditions. In rat liver homogenates the aerobic carbon dioxide production with a glutamate substrate exceeded the production under anaerobic conditions both at pH's of 7.4 and 5.8. Brain homogenates appeared to be somewhat less active than comparable liver preparations. At a pH of 7.4 no activity could be observed in brain preparations over blank determinations, while at a pH of 5.8 the aerobic carbon dioxide evolution exceeded the anaerobic and blank determinations. In studies of oxygen uptake the presence of 4-aminobutyric acid in liver and brain homogenates was found to enhance oxygen uptake at a pH of 5.8. At a pH of 7.4 there was little or no difference over a set of controls.

A mold species of *Verticillium* was found that is capable of utilizing 4-aminobutyric acid as its sole source of carbon and nitrogen.

Studies with labelled glutamate in squash homogenates revealed 4-aminobutyric acid as the only metabolic product, and all indications seem to be that 4-aminobutyrate is not metabolized further under these conditions. Attempts to demonstrate the reaction in intact squash tissue by inhibition were unsuccessful. Either the substrate did not penetrate into the cell, or the reaction is inhibited in the intact tissue.

87 pages. \$2.00. Mic 57-2177

A COMPARATIVE STUDY OF SURFACTANT INFLUENCE ON THE RELEASE OF RADIO-LABELED IONS FROM AN EMULSIFIED OINTMENT BASE

(Publication No. 21,315)

John Frederick Stark, Ph.D.
Purdue University, 1957

Major Professors: John E. Christian and H. George DeKay

The subservience of the newer hydrophilic bases must of necessity be a measure of their ability to release a contained medicinal agent. The hydrophilic character of the emulsified semisolid, the surfactant classification and concentration and the particle size, solubility and pH of the incorporated medicament appear, among other factors, to influence the release pattern.

An *in vitro* method, closely simulating the actual conditions under which a medicated ointment is frequently used, was developed to study medicament release. Because of the ease and extreme sensitivity of detection, radioisotope labeled compounds were employed to represent the medicinal fraction of the hydrophilic bases.

An apparatus supporting a synthetic membrane and a

bismuth cathode side-window counter was constructed. Efficient circulation of a contained physiological solution was achieved by controlled magnetic stirring in a compartment beneath the membrane station. A copper housing filled with lead shot, when placed across the connecting arms of the apparatus, completely isolated the counter from the applied labeled base.

A second piece of equipment, modeled after and identical to the counter housing and chamber of the above described release apparatus, was designed to standardize the individual bases prior to the release study.

The bases were modifications of the U.S.P. XV hydrophilic ointment. Twenty-four surface active agents, anionic, cationic and non-ionic, were employed in three concentrations to formulate the bases. Sodium radioiodide (I^{131}) and labeled mercuric nitrate (Hg^{203}) were used as the analytical tools in conjunction with the vehicles.

In practice the isotope was thoroughly incorporated into the vehicle, a weighed portion of which was standardized to determine its activity. A foil backed lucite holder was evenly filled with the labeled base, the total activity of which was calculated from the standardization data.

The base contained in a lucite holder was positioned in contact with the membrane of the release apparatus. As the labeled medicament diffused through the membrane and into the physiological solution maintained at 37° C., the radioactivity was detected and measured with a Geiger counter. The ability of each base to exert its therapeutic action was determined by counting the solution over a three hour period. Proper mathematical evaluation was applied to express the release from each base in terms of per cent.

An overall evaluation of the data demonstrated that the release of both iodide and mercuric ions from the hydrophilic vehicles was retarded as the surfactant concentration was increased. This phenomenon was evidenced with both ionic and non-ionic groups of surface active agents. It is assumed that the increased amounts of emulsifier tended to fortify the hydrophilic nature of the base, thus decreasing the ability of the base to release a water soluble labeled medicament.

The surfactant classification was instrumental in influencing the release from the emulsion bases. The non-ionic group exhibited an enhanced ability over the ionic group to allow the diffusion of the labeled ions into the physiological solution. Incorporated medicinals are not antagonized by non-ionic agents due to their relative inertness and conditions more favorable for release are established.

This newly developed *in vitro* approach is believed to possess certain advantages over other *in vitro* procedures. The method enjoys the sensitivity inherent to isotopic measurements and compounds with a labeled atom that are allowed passage by a suitable membrane can be studied. The per cent release of the labeled atom can be determined over any desired time interval.

109 pages. \$2.00. Mic 57-2178

PHILOSOPHY

JOHN DEWEY'S DEMOCRATIC LIBERALISM: ITS PHILOSOPHICAL FOUNDATIONS

(Publication No. 21,335)

Harold Austin McNitt, Ph.D.
University of Michigan, 1956

The aim of this essay is to elucidate the relationship between John Dewey's theory of democracy and his general philosophical ideas about the nature of the world and man. It is concerned to discover, first, whether or not there is a direct connection between Dewey's democratic political theory and his general philosophic position, and secondly, if there be such a connection, what its nature is.

In order adequately to undertake this task, it is necessary to investigate certain general elements of Dewey's philosophy. Since the latter claims to be based entirely on the methods and results of science, it is first necessary to explicate Dewey's theory of the scientific method. This in turn requires that the concept of situation be examined. The first chapter is devoted to this two-fold task.

The second and third chapters are complementary, in that each deals with a fundamental constituent of every human situation, as Dewey defines it. The first of these is the biological human organism; the second is the cultural environment. The fourth chapter then unites these two conceptions. It describes Dewey's theory of the way in which individual selves, manifesting distinctively mental forms of behavior, emerge when human organisms engage in activities employing symbols. His interpretation of development is explained also in terms of Dewey's theory of meaning-symbols.

The fifth chapter presents an interpretation of Dewey's theory of moral deliberation which is in some respects new. It is shown that Dewey implicitly assumes an "ultimate end," namely, that every unsatisfactory situation ought to be transformed into a satisfactory one. It is also shown that in human situations, according to Dewey, this transformation can occur only if there is development of all persons in the situation. This interpretation provides a link between Dewey's theory of value and his political philosophy.

The remainder of this work deals specifically with Dewey's social and political philosophy. First, his theory of the nature of human associations and the means for evaluating them is considered in the sixth chapter. Then, in the following chapter; Dewey's conception of democracy as a broad social ideal, as a "way of life," is explicated. Emphasized throughout is Dewey's central doctrine that the development of individuality is a direct function and consequence of cooperative social behavior. In political terms, this means that genuine liberty in any association requires equality of participation in the formation and realization of shared ends.

This work next considers Dewey's theory of the nature of democratic political states. Three reasons are presented by Dewey, in the course of his many writings on democracy, for his belief that democratic political forms are desirable: (1) The democratic state best conduces to

the "democratic way of life." (2) It best fulfills the specific function of all states, i.e., promotion and protection of the "public interest." (3) It is the best means yet devised for producing satisfactory social situations through the application of intelligent deliberation.

The final chapter considers, by way of illustration, a few of the ways in which Dewey's political philosophy is implemented for practical application.

The conclusion of this work is that there is indeed a connection between Dewey's theory of democracy and his general philosophic ideas. His interpretation of many of the most important concepts employed, such as development, liberty and equality depends upon his general position. More specifically, the third of the arguments listed above for democratic forms of government, i.e., that they best conduce to satisfactory social situations, is directly based on his theory of moral deliberation. The latter, in turn, is intimately connected to his social psychology, his theory of meaning, and his conception of the method of science. 336 pages. \$4.30. Mic 57-2179

A STUDY OF JAPANESE TASTE WITH AN OBSERVATION CONCERNING FURYU AND THE STRUCTURE OF IKI BY KUKI SHUZO (PARTS I AND II)

(Publication No. 19,386)

Masaru Victor Otake, Ph.D.
Syracuse University, 1956

In this dissertation on Japanese taste, the history of three large ideas is treated — Mono no aware, Furyu and Iki.

While Mono no aware, the deep feeling of thing(s), was formulated into a literary theory by Motoori Norinaga towards the end of the eighteenth century, it referred to the sensibility of the Heian Period (794-1192), as exemplified in The Tale of Genji by Lady Murasaki. Aware does not necessarily mean sadness, but it is a deeper and more harmonious feeling than Okashi (humorous, interesting) of Sei Shonagon. Today Mono (thing(s) of Mono no aware is the center of arguments among the critics. Unlike Motoori, who thought it was simply the deep feeling of things, the latest scholars interpret it as sensibility harmoniously fused out of many perceptions. Mono no aware, then, is the spirit of seeing things through empathy and achieving harmony with Nature, love and the world after death.

When the Chinese idea of Furyu was imported, it was soon identified with the idea of Miyabi. But during the Heian Period, Furyu already began to show antithesis; Miyabi as esthetic refinement on one side, and Misao as ethical constancy on the other.

In the Middle Ages there were three types of Furyu: the Furyu of courtiers who maintained the Miyabi of the Heian aristocracy, the Furyu of the warriors and the

commoners in the form of Basara (swaggering and romantic) and the Furyu of priests and recluses in the form of Suki or devotion to refined taste.

In the Tokugawa Period, Ihara Saikaku made Furyu synonymous with the sensibility of Amour, while Matsuo Basho made it a rustic sensibility of Haiku spirit. Furyu, then, strives to bring the work-a-day life towards art rather than art towards life. It is Oriental rather than exclusively Japanese.

Now, Iki is the sensibility of Edo (Tokyo), particularly of its common people. The daring spirit and subdued color taste marked their sensibility and their pleasure-life in the gay quarters of Yoshiwara and in the Kabuki theaters and had much to do with Iki. In the study of Iki, careful observations were made of customs, paintings, music, and literature of the Edo Period, particularly between the latter half of the eighteenth century and the early part of the nineteenth century. This sense of Iki was further refined and integrated in the twentieth century, as is expressed by Kuki Shuzo in Part II of this dissertation.

In the concluding Chapter of Part I, the impact of the Western culture is briefly introduced so as to clarify the difference between the Western type of gentleman and the Japanese man of taste.

If Part I is an attempt to deal with the history of Japanese ideas, first of its kind available to English readers, Part II is the philosophical exposition of Furyu and Iki executed by Dr. Kuki Shuzo, one of the foremost modern philosophers in Japan. 236 pages. \$3.05. Mic 57-2180

WHITEHEAD'S THEORIES OF PERCEPTION:
AN EPISTEMOLOGICAL SOURCE
OF SPECULATIVE PHILOSOPHY

(Publication No. 20,157)

William Stover Snyder, Ph.D.
Princeton University, 1955

In speculative philosophy all problems are interrelated and one has not clearly understood a view until one sees the interrelations among the basic problems. I have tried to make clear the relation, on Whitehead's views, between two questions: "What is the basic structure of scientific knowledge and its process of validation?" and "What is the nature of mind and its relation to the real?" I hope to have contributed at the same time to a clarification of some of the issues surrounding the epistemological problems connected with the first issue.

My mode of procedure has been to examine Whitehead's analysis of the structure of scientific knowledge in An Enquiry Concerning the Principles of Natural Knowledge and The Concept of Nature. This material is covered in Chapters 1 and 2. The result of the examination is the demonstration that the systematic analysis there given is incomplete in the sense that a series of assumptions, delimiting the area of enquiry, are made whose justification is possible only outside of the analysis itself. I then suggest how similar conclusions could stem from the examination of any epistemological analysis of the sort attempted by Whitehead.

In Chapters 3 and 4, I outline the speculative system of Whitehead and show how that system permits a derivation

of the particular assumptions made in the analysis of scientific knowledge. I treat the speculative system as an ontological system, in a sense discussed in Chapter 3. It provides a set of basic concepts (categories) in terms of which an analysis may be provided for all concepts.

Chapter 5 contains a group of reflections in the nature of summary of, criticism of, and comment on material in the rest of the dissertation. It also includes a few reflections on the nature of speculative philosophy.

218 pages. \$2.85. Mic 57-2181

LANGUAGE AND COGNITION: AN EXAMINATION
OF THE HYPOTHESIS THAT LANGUAGE INFLUENCES
HABITUAL PERCEPTION AND THOUGHT

(Publication No. 21,376)

Maxwell Freeman Yalden, Ph.D.
University of Michigan, 1956

The purpose of this dissertation is to make clear and to examine the hypothesis that language is one of the determinants of habitual perception and thought, an hypothesis which is called in this essay "the ethnolinguistic thesis (hypothesis)," and to point out its relevance to and importance for philosophical thinking.

Chapters I and II, in addition to settling questions of terminology, are devoted to a discussion of the history of the ethnolinguistic thesis. In Chapter I a European and an American development are distinguished and discussed briefly, and the two traditions are compared, the former being seen to be characteristically speculative in its orientation, and the latter to be concerned primarily with empirical questions in ethnology and linguistics. No further consideration is given to the European movement. Chapter II is given over to an elucidation of the work of Benjamin Lee Whorf, the major exponent of the hypothesis in America, and to the writings of certain other scholars who have worked along similar lines. Their views are examined in some detail, with as little comment and criticism as possible, in order to determine exactly how they have claimed the hypothesis should be formulated, and to discover such other doctrines as they might be willing to allow but do not explicitly set forth in their writings.

In Chapters III and IV various objections to the ethnolinguistic thesis are discussed — both as it was formulated by Whorf and those in his tradition, and as it might be put by anyone attempting to set it forth — and with these in mind a generalized formulation of the theory is put forward. The latter formulation is couched in terms which are intended to enable it to escape such difficulties as have been raised previously, and which will make it more readily capable of being supported by evidence from the social sciences.

In Chapters V and VI such evidence is dealt with in some detail, first via an attempt to support the contention that "mental sets" — in terms of which linguistic influences are explained in this essay — are operative to a significant degree in cognition, and second by showing that group, cultural, and, in particular, linguistic factors may be in part responsible for the establishment of such sets in the individual, and thus that modes of cognition may differ from one linguistico-cultural group to another.

The final chapter of the essay is devoted to a discussion of the relevance to and importance for philosophy of the hypothesis as formulated and developed in the preceding four chapters, particularly by means of a discussion of certain facets of the philosophy of Henri Bergson.

The main conclusions of the dissertation are two: first, that the ethnolinguistic hypothesis is significant when expressed in terms of linguistically determined mental sets, and that there is evidence to be drawn from

the social sciences which will support it when it is so formulated; and second, that the hypothesis is of value (particularly as it may be developed in the future) to philosophers as a means of evaluating linguistic influences on philosophic positions, in interpreting the history of philosophy, in the reinterpretation of certain points of view in philosophy, and finally, perhaps even in original philosophical work.

333 pages. \$4.30. Mic 57-2182

PHYSICS

PHYSICS, GENERAL

THE PURE ROTATIONAL ABSORPTION SPECTRUM OF FORMALDEHYDE

(Publication No. 21,429)

Cecil Frederick Dam, Ph.D.
The Ohio State University, 1956

Formaldehyde (CH_2O) gas was prepared by heating paraformaldehyde; precautions were taken to make sure that the gas was free from water vapor. The far infrared spectrograph at the Ohio State University was used to record the CH_2O absorption spectrum between about 20 cm^{-1} and 80 cm^{-1} .

Since CH_2O is an asymmetric rotator, one cannot calculate its energy eigenvalues by use of one simple equation but must resort to other means. Altogether, the rigid rotator energy term values $F(J_t)$ for $J = 1$ through $J = 22$ were calculated. The rotational constants used were the values reported by R. B. Lawrance and M. W. P. Strandberg in the *Physical Review*, Vol. 83, p. 363 (1951). The term values for $1 \leq J \leq 12$, and for $J > 12$, $\tau > 0$, were obtained as the result of five-point Newtonian interpolations in available asymmetric rotator "reduced" energy eigenvalue tables. In addition, the eleven lowest term values corresponding to $K_{-1} = 0, 1, 2, 3, 4$, and 5 were calculated for each J from $J = 13$ through $J = 22$ by the method of continued fractions as outlined by G. W. King, R. M. Hainer, and P. C. Cross in the *Journal of Chemical Physics*, Vol. 11, p. 27 (1943). An excellent first choice for use in this iterative process was obtained for each eigenvalue by a five-point extrapolation in J of the family of K_{-1} levels to which it belonged. Relative intensities of the absorption lines were calculated by using symmetric rotator transition probabilities, this being a satisfactory approximation for CH_2O , which is only slightly asymmetric.

The agreement between the observed and calculated rigid rotator spectra was an excellent one. If an absorption line of significant intensity was separated from its neighbors by half of a reciprocal centimeter, which was about the limit of resolution of the spectrograph, then it was observed. It is difficult to make a precise comparison between observed and calculated line intensities, but even here the two spectra agreed in so far as it was possible to make comparisons. This excellent agreement between the observed and calculated spectra must be taken as an indication of the correctness of the parameters of

Lawrance and Strandberg. An important conclusion is that the CH_2O molecule does not suffer appreciable centrifugal distortion in its vibrational ground state.

93 pages. \$2.00. Mic 57-2183

INTENSITIES OF RESONANCE TRANSITIONS BETWEEN HYPERFINE LEVELS

(Publication No. 20,119)

Melvin Nathaniel Hack, Ph.D.
Princeton University, 1956

The theory of resonance transitions between hyperfine levels, as observed in atomic and molecular beam experiments, is the subject of this thesis. The solution of the time-dependent Schroedinger equation is studied for a system of coupled angular momentum vectors subjected simultaneously to a homogeneous static magnetic field and a perpendicular radiofrequency magnetic field. In the case of a rotating radiofrequency field there are shown to exist steady state solutions of the Schroedinger equation, which lead to a general solution for the wave function and transition probabilities in terms of an eigenvalue problem. These solutions are applied to the derivation of the connection between the transition probabilities for opposite signs of the nuclear magnetic moment. The origin of this connection is shown to reside, for arbitrary radiofrequency fields, in the time inversion symmetry of the system. A theorem is stated and proved which characterizes the connection of the low to the high field hyperfine pattern.

Multiple quantum transitions are studied both at low r.f. fields and at higher fields where time-dependent perturbation theory is no longer a good approximation. At low fields the transition probabilities are obtained from the solutions of the recursion relations for the transition matrix. The rotating field case reduces to a time-independent problem, for which the recursion relations are solved explicitly. The transition probabilities at higher fields are derived, under certain conditions, for oscillating and two frequency, as well as for rotating, r.f. fields. The "double resonance" case in the two frequency problem, where the applied frequencies are separately equal to eigenfrequencies of the system, is treated to fourth order terms in the r.f. field strengths.

114 pages. \$2.00. Mic 57-2184

TWO TOPICS IN THE THEORY
OF HINDERED ROTATION IN MOLECULES:

- I. HINDERED ROTATION IN MOLECULES WITH
RELATIVELY HIGH POTENTIAL BARRIERS.
- II. THE $J = 0 \rightarrow 1$ TRANSITION IN METHYL ALCOHOL.
VIBRATION-HINDERED ROTATION INTERACTIONS
IN METHYL ALCOHOL.

(Publication No. 19,698)

Karl Theodor Hecht, Ph.D.
University of Michigan, 1956

Two topics in the theory of hindered rotation are presented. The first is an application of the theory of hindered rotation to molecules in which the hindering barrier is high enough that the hindered rotation splittings of the energy levels are small compared with the rigid rotator energies and yet low enough that the splittings will be easily observable in the microwave spectrum. The specific type of molecule considered is assumed to consist of a rigid asymmetric component which may undergo a hindered rotation about the symmetry axis of a rigid symmetric component where the symmetric component is in addition assumed to have three-fold symmetry and the asymmetric component at least a plane of symmetry containing the symmetry axis of the symmetric component.

In principle the theory developed by Burkhard and Denison can be used directly but in practice the method is difficult to apply to such a molecule since the matrix elements of their Hamiltonian do not degenerate naturally or easily to those for the rigid asymmetric rotator in the infinite barrier limit. In the present treatment a transformation is made on the Hamiltonian whereby this complication is avoided.

It is shown that the spectrum is essentially that of the rigid rotator with the important exception that all the strong lines are split into two components. For the low J transitions specific formulae have been derived for these splittings which are relatively simple functions of the barrier height, the principal moments of inertia, and two additional molecular parameters. The barrier height can thus be deduced from the observed splittings without the use of the rather cumbersome machinery needed in the general case.

The second topic is a discussion of the $J = 0 \rightarrow 1$, $K = 0 \rightarrow 0$ lines in methyl alcohol which have been observed by Venkateswarlu, Edwards, and Gordy* for the normal molecule as well as for five additional isotopic species. Since the transitions in the torsional states $n = 0, 1$, and 2 have been found to be split these data comprise some 36 frequencies. Although these frequencies are understood qualitatively on the basis of the simple theory of hindered rotation, a quantitative explanation of the irregular behavior of the line splittings must be based on a theory including the contributions of the vibration-hindered rotation interactions. These interactions have been examined and lead to a frequency formula containing essentially four new rotational constants. Three of these depend solely on the elastic force constants and the known structure of the molecule. In principle they can be calculated exactly, although to obtain the best fit the constants for the normal molecule have been subjected to a slight adjustment which is, however, not inconsistent with the infrared spectrum. The fourth constant describes the dependence of the barrier height upon the normal coordinates and has to be

determined empirically for each isotopic species. The 30 line separations may thus be calculated with the aid of essentially only six empirical constants with generally quite good agreement between theory and experiment.

228 pages. \$2.95. Mic 57-2185

*P. Venkateswarlu, H. D. Edwards, and W. Gordy.
J. Chem. Phys., 23, 1195, (1955).

SOME CONSEQUENCES OF MACH'S PRINCIPLE
FOR THE GENERAL THEORY OF RELATIVITY

(Publication No. 20,127)

Arthur Baraway Komar, Ph.D.
Princeton University, 1956

The Mach principle that the local inertial frame is determined by the distribution and motion of matter in the universe, is discussed, and the implications which this principle has for the general theory of relativity are enumerated. The investigation of the extent to which these implications are found to be contained, or can be included within the Einstein theory, forms the main body of this paper. It is found that (a) the inductive effects of neighboring matter holds very generally; (b) the uniqueness of the local inertial frame subject to very general boundary conditions is still open, but subject to doubt; (c) a wide number of empty spaces, particularly those which admit a group of motions, are locally flat (subject to an appropriate definition of empty); (d) flat space times can be rejected as solutions of the Einstein field equations if we are willing to allow the imposition of a natural set of four additional second order differential equations which can be satisfied only by the most asymmetric solutions of the Einstein field equations. These latter asymmetry conditions have the virtue that they enable one to obtain locally an intrinsic means of specifying points, and therefore, distributions of matter. It is suggested that the aspect of Mach's principle requiring the local inertial frame to be at rest (or in a state of uniform translation) relative to the average motion of the fixed stars, is a consequence of the symmetry of the distribution of matter in the universe, and that such a conspicuous empirical relationship probably would not hold true for a radically different distribution of matter. We conclude with some speculation as to what directions remain open for further including Mach's principle within general relativity.

As byproducts of this discussion we (a) develop a theorem in terms of scalars for the local equivalence of two quadratic forms; (b) prove that if a space whose Ricci directions are not degenerate admits at most $4-r$ functionally independent scalars constructed from the metric, it necessarily admits Killing vectors in r independent directions; (c) show that cosmological models which exclude negative pressure terms, and which assume that the average motion of matter in the universe is sufficiently uniform as to permit the selection of a comoving coordinate system for matter, necessarily have singular points in time; (d) generalize the equation for gravitational waves to a curved metric.

95 pages. \$2.00. Mic 57-2186

SMALL ANGLE X-RAY SCATTERING STUDIES OF THE SIZE, SHAPE, AND HYDRATION OF CATALASE

(Publication No. 21,223)

Arthur Gerald Malmon, Ph.D.
The University of Wisconsin, 1957

Supervisor: Professor William Beeman

The applicability of small angle x-ray scattering to the study of protein molecules in solution is well established. This work represents an effort to obtain the maximum amount of information, using the available theory and technique, concerning the hydrated molecule of catalase, an enzymatic protein.

Because there are no extensive calculations of theoretical scattering functions for randomly oriented shapes which are not spherically symmetric, the first part of this work is to evaluate numerically certain theoretical expressions for the scattering from ellipsoids of revolution and right circular cylinders, using an electronic digital computer. These calculations show that, for elongated figures, subsidiary maxima appear in the scattering curve, and that their position is a function of the equatorial radius of the particle. As an experimental demonstration of this phenomenon, x-ray scattering experiments are described on a solution of randomly oriented tobacco mosaic virus.

The x-ray scattering curve for catalase has been determined over an intensity range extending to 6×10^{-4} of the central intensity. The electronic radius of gyration of the molecule is 39.8 Å. The shape was studied by comparing the experimental scattering curve with the theoretical curves mentioned above. It appears to be slightly elongated, with the length about twice the average cross-sectional diameter. The electron pair distribution is calculated from the scattering curve, and indicates a maximum length of the molecule of about 146 Å.

To study the hydration of the molecule, x-ray scattering is measured from solutions in which the solvent electron density is varied. The results from experiments using sucrose, glycerol, and sodium chloride to increase the solvent electron density are similar. The average electron density of the catalase molecule in solution is 0.425 electron/Å³. The shape of the scattering curve, out to 10^{-2} of central intensity, showed little change, indicating that the shape of the molecule itself was preserved under conditions of high solvent density. The results are interpreted as indicating that there is considerable internal water of hydration in the solvated catalase molecule.

76 pages. \$2.00. Mic 57-2187

DEVELOPMENT OF HYDROCARBON BUBBLE CHAMBERS FOR USE IN NUCLEAR PHYSICS

(Publication No. 21,349)

David Charles Rahm, Ph.D.
University of Michigan, 1956

The purpose of this work has been to investigate the influence of ionizing radiation on the boiling of superheated liquids with a view towards developing apparatus

suitable for quantitative use in the study of high energy nuclear phenomena.

The first experiments by Glaser on the influence of radiation on the boiling of superheated liquids were done using all-glass chambers. Further work on all-glass chambers has been carried out and photographs of tracks have been obtained in these chambers using several different triggering methods. Since high pressures were required, the size of the chambers was limited. A chamber which had an aluminum body, glass windows and Teflon gaskets and which was expanded manually was tried, but proved unsuccessful. Wood, at the University of California, working with liquid hydrogen in a somewhat similar chamber, was able to observe tracks when the chamber was expanded rapidly. Using this fast expansion technique, a six-inch chamber has been operated successfully using hydrocarbons, and chambers of any size appear possible, at least in principle.

The lifetime in isobutane of bubble nuclei left by ionizing radiation has been investigated using a pulsed source. This lifetime was found to be less than 300 microseconds, and is probably very much less. The possibility of using counter-controlled expansions is therefore unlikely, but the bubble chamber is well suited for use with high energy machines where the time of arrival of the radiation is known.

The relation between bubble density along a track and the velocity of the particle that made the track has been studied and the bubble density has been found to be a reproducible function of the velocity. The bubble density as a function of the temperature has also been investigated and is reported here.

Measuring bubble density and curvature in a magnetic field should thus permit the determination of the masses of particles. Masses may also be determined by studying the bubble density as a function of the residual range for particles that stop in the chamber. A particle stopping and decaying in the chamber has been tentatively identified as a K meson using the latter technique.

82 pages. \$2.00. Mic 57-2188

THE EFFECT OF THE SOURCE APERTURE ON DIFFRACTION GRATING IMAGES

(Publication No. 20,218)

Albert Ernest Smith, Ph.D.
Michigan State University, 1954

In a previous work Smith and Hause (1) derived an expression for the intensity distribution in the Fraunhofer pattern of a diffraction grating with N apertures as a function of the breadth of the illuminating aperture where the source aperture was illuminated in the noncoherent mode. Almost simultaneously Takeyama, et al. (2) arrived at the corresponding expression for a grating with a small number of apertures illuminated in the coherent mode. Both of these expressions were extremely cumbersome in case of a diffraction grating with a large number of apertures. No experimental verification existed for the coherent mode, and the verification for the noncoherent mode was limited to the behavior of the subsidiary maxima as a function of source breadth in the case of a grating with a small number of apertures.

In this work both expressions mentioned were simplified so that they could readily be used to find the intensity distribution in the image formed by the diffraction grating of many apertures. Particular attention was given to the intensity distribution in the principal maxima.

The results obtained for the diffraction grating were compared with the results which Van Cittert (3) obtained in his calculations of the intensity distribution in the images formed by a single diffracting aperture. Within the limits of the assumptions used to simplify the grating theory no differences were found. In the grating theory it was assumed that the source aperture was located on the axis of the grating and that the angle subtended by the source aperture was sufficiently small that the first order approximation could be used for the sine of the angle and that N was large.

These results were verified in the laboratory by direct measurement of the intensity in the grating image. Two different gratings were used of different N values and measurements taken over a wide range of values of the source aperture breadth. The results obtained were compared graphically with the theoretical results. Three different modes of illumination as suggested by Stockbarger and Burns (4) were used and the results of the comparison were interpreted in terms of the degree of coherence or noncoherence of the source aperture. Measurements were also made on the image formed by the single aperture as a means of verifying Van Cittert's calculations and of checking the conclusion of the present calculation that the two theories give the same result. No difference was evident.

(1) Smith, A. E., and C. D. Hause, Fraunhofer Multiple Slit Diffraction Patterns with Finite Sources, J. Opt. Soc. Am., 42, 426-430 (1952).

(2) Takeyama, H., T. Kitahara, and T. Matubayasi, On the Mathematical Treatment of the Effect of the Width of the Slit on Fraunhofer's Diffraction Phenomenon (Part II), J. Sci. Hiroshima Univ. (S.A.), 15, 139-146 (1951).

(3) Van Cittert, P. H., Zum Einfluss der Spaltbreite auf die Intensitätsverteilung in Spektrallinien, Z. Physik, 65, 547-563 (1930).

(4) Stockbarger, D. C., and L. Burns, Line Shape as a Function of Spectrograph Slit Irradiation, J. Opt. Soc. Am. 23, 379-384 (1933). 109 pages. \$2.00. Mic 57-2189

THE PRODUCTION OF VERY HIGH TEMPERATURES IN THE SHOCK TUBE WITH AN APPLICATION TO THE STUDY OF SPECTRAL LINE BROADENING

(Publication No. 21,364)

Eugene Bonner Turner, Ph.D.
University of Michigan, 1956

Shock tubes have been used by many investigators since World War II for shock-wave and aerodynamic studies. The study of luminous shock waves produced in shock tubes was not begun until approximately five years ago, however. The principal work in the field has been done at Cornell University and at The University of Michigan. The former institution has confined its studies, for the

most part, to the flow behind the primary shock wave. In this thesis, however, the author has made most of his observations on the region behind the reflected shock at the end of the tube where the temperature is somewhat higher than behind the primary shock wave. The principal aims of this research were to understand the hydrodynamics of the flow and to utilize the shock tube as a spectroscopic light source for the study of spectral line broadening at high temperatures and ion densities.

A principal part of the work was the design and construction of a shock tube for the production of very strong shock waves. It is vacuum tight and is pumped out with an oil-diffusion pump, insuring the purity of the test gases. The tube is rectangular and has a test section with flat side windows designed for the observation of the luminosity at the end of the tube. Wave-speed photographs of the shock waves were obtained with a revolving drum camera. Both a prism and a grating spectrograph have been used to obtain spectra of the luminosity at the end of the tube, and time-resolved spectra have been obtained by the use of a revolving drum camera.

The theory is given for the interaction of the reflected shock with the interface where, in most cases, a shock is reflected back into the luminous gas. The effect of ionization on the hydrodynamics is also considered. Monatomic gases have been used almost entirely in the low-pressure chamber to eliminate temperature reduction by vibrational excitation and dissociation.

Wave-speed photographs were taken of the region at the end of the tube for shots into the rare gases for a large range of initial pressure ratios. The primary shock velocities measured from these photographs were considerably less than the theoretical values, indicating a large attenuation of the shock strengths. Reflected shock velocities in argon showed a decrease from the ideal theory due to ionization behind the reflected shock. For the shock strengths produced, ionization occurred behind the primary shock in xenon but not in argon. In xenon one first observes the thin luminous shock front, and then, after a delay of a few to hundreds of microseconds depending on the shock strength, ionization occurs and the gas becomes luminous. This delay time was measured for several different densities and shock velocities. The luminosity of the shock front was found to be due to the molecular bands of C_2 and CN.

Spectra of the luminosity in the rare gases show such qualitative features as the lines of metallic impurities, the continuum due to recombination of ions and electrons, and the second-order Stark broadening of rare-gas lines. The argon lines exhibited a red shift and symmetric broadening, while an asymmetry was seen in the xenon lines. Strong Balmer lines are seen behind the reflected shock wave in a mixture of 1% hydrogen in neon. Time-resolved spectra were taken of the H_β line with suitable relative intensity film calibrations. The resulting line profiles were about 20% wider than the Holtsmark theory lines for the ion densities calculated from the primary shock velocities. This has been explained by Kolb as the additional broadening due to the fast-moving electrons.

179 pages. \$2.35. Mic 57-2190

PHYSICS, ELECTRONICS AND
ELECTRICITYROOM TEMPERATURE POLONIUM ALPHA
IRRADIATION OF THIN GERMANIUM LAYERS

(Publication No. 21,271)

William Martin Becker, Ph.D.
Purdue University, 1957

Major Professor: Karl Lark-Horovitz

Using single crystal layers of germanium (a) small as compared to the range, and (b) thick as compared to the range of polonium alpha particles, irradiation effects have been observed at room temperature. The thickness of these samples, determined by optical, electrical, and weight methods agree within the limits of experimental error. Four different sources of polonium have been used and the fluxes from these sources have been determined experimentally as well as theoretically.

Defect production using hard collisions has been calculated from Rutherford scattering and an estimation of secondaries produced by collision with the lattice atoms. These figures in turn have been compared with the removal rates of electrons and the introduction and removal rates of holes as a function of Fermi level. Removal rates in nearly degenerate N-type samples reach 230 electrons per incoming alpha particle. A rate of 8 holes removed per incoming alpha particle is obtained on the P-type side.

Healing at the bombardment temperature (room temperature) on the N-type side is extremely slow, if it exists at all. On the P-type side, healing periods of the order of minutes and hours are observed.

After complete conversion from N to P-type, the defects seem to be "permanent" at the bombardment temperature, in agreement with neutron and deuteron irradiation, but in striking contrast to electron irradiation where practically the whole irradiation curve is recovered in healing at bombardment temperatures.

141 pages. \$2.00. Mic 57-2191

THE TRANSMISSION OF ELECTROMAGNETIC WAVES
THROUGH WIRE DIFFRACTION GRATINGS

(Publication No. 21,348)

William Knox Pursley, Ph.D.
University of Michigan, 1956

This thesis reports an experimental survey of the transmission of electromagnetic waves through wire diffraction gratings with the wave length of the radiation equal to or larger than the grating space. Hertz first noticed that such grids have the curious property of reflecting a wave whose electric field is oriented parallel to the wires, while transmitting freely the perpendicularly polarized wave.

The dependence of the transmission upon the following factors was studied: direction of polarization, ratio of the wave length $[\lambda]$ to grating space $[D]$, angle of incidence, ratio of the wire width $[2A]$ to grating space, and shape of

the wires [cylindrical or flat]. Measurements were made with 3 cm microwaves on gratings that were 35 cm square having values of λ/D from 1 to 5 and values of D/A from 2.5 to 16. Further data was obtained with a specially constructed far infrared spectrometer that isolated wave lengths from 0.008 to 0.05 cm. The gratings used here were 7 cm square and had D values of 0.010 and 0.0187 cm and D/A equal to 3.3 and 4.0. The probable error in the transmission coefficients determined from either apparatus was about one per cent. The majority of the measurements [including all effects of oblique incidence and wire form] were made with microwaves.

The general features of the transmission for the parallel polarization were:

- a] a transmission peak at $\lambda = D$ [apparently always 100%]
- b] a monotonic decrease in transmission to zero as the wave length increased
- c] a decreased transmission at all points except at $\lambda = D$ as the value of A increased
- d] gratings of strips were slightly more transparent than those of wires.

Noteworthy points for the perpendicular polarization were:

- a] the appearance of a transmission maximum at $\lambda = 1.22 D$ for wires. The maximum was more pronounced for large values of A , but did not occur at all for strips
- b] the transmission approached 100% as the wave length increased
- c] the transmission decreased with increasing A .

The effect on the transmission coefficient of oblique incidence was generally small except at angles of incidence such that a diffracted spectral order was possible at a 90° angle of emergence from the grating.

The empirical coefficients for wire gratings were checked against those calculated as successive approximations to the exact series solution derived by Ignatowsky.¹ For D/A large [10 or more], the first and second approximations had nearly identical values and were closely matched by the measurements [within 1%]. As D/A decreased, the higher approximations are necessary, especially as λ/D approaches unity. The convergence rate of these series solutions appeared to be considerably more rapid for the parallel polarization than for the perpendicular.

Transmission coefficients observed for the perpendicular polarization with a strip grating having $D/A = 4$ were in excellent agreement with those calculated from an exact solution derived by Baldwin and Heins.²

81 pages. \$2.00. Mic 57-2192

1. W. v. Ignatowsky, Ann. der Physik 44, 369 [1914].

2. Baldwin and Heins, Math. Scand. 2, 103 [1954].

PHYSICS, NUCLEAR

EFFECTS OF DYNAMICAL CORRELATIONS
ON THE NUCLEAR PHOTOEFFECT

(Publication No. 21,079)

Hugh Edgar DeWitt, Ph.D.
Cornell University, 1957

Approximate nuclear wave functions for neutron-proton pairs which include the correlation effects due to the n-p interaction were calculated and used to estimate the peak energy of the giant resonance of the nuclear photoeffect. In this model a γ -ray is absorbed by an n-p pair which recoil from each other and are excited to a quasi-stationary state which decays when either the neutron or proton collides with another nucleon thus sharing the γ -ray energy and setting up a compound nucleus.

The wave functions for the ground state of the pair were obtained by approximating the overall nuclear potential with a harmonic oscillator. The assumption of an oscillator shape allows the separation of the two particle Schrodinger equation into an equation for the center of mass motion and an equation for the relative motion which contains the n-p interaction. The relative motion eigen functions are distorted from the oscillator eigen functions by the short ranged but very strong interaction at the bottom of the relative motion oscillator well. In relative angular momentum states of zero the n-p interaction will cause very strong correlations and decrease the eigen energy by several Mev from the oscillator eigen energy. A method was developed for solving the relative motion equation for different assumed shapes of the interaction.

The wave function of an n-p pair each with angular momenta as good quantum numbers may be expanded as a sum of products of center of mass oscillator eigen functions and distorted oscillator relative motion eigen functions. This wave function describes n-p pair as scattering each other, and outside the effective range of the interaction it is similar to a product of shell model wave functions. The n-p pair may be excited by dipole absorption in any of the "quasi-deuteron" states in the expansion with the center of mass motion remaining unchanged except for the photon momentum. For most of these states only transitions to continuum final states are possible. Direct ejection is considerably enhanced by the high momentum components introduced by the n-p interaction. The lowest energy relative motion state, the nodeless s state, is very strongly affected by the n-p interaction and is near the bottom of the nuclear well. Resonant transitions from this state are possible to a bound p state which may be approximated as the first p state of an oscillator. This transition accounts for most of the dipole oscillator sum for transitions from this state. Each n-p pair will have some component of the nodeless s state in its expansion; hence the giant resonance is the sum of contributions from NZ pairs.

The resonance energy is the oscillator unit energy plus the interaction energy of the nodeless s state. The relative motion eigen functions and the interaction energies were calculated using a square well interaction and an exponential interaction both chosen to agree with n-p scattering data. The wave functions and the interaction energies are very dependent on the shape of the interaction. With a square well interaction the resonance energies

calculated by this method agree well with the experimental values for both light and heavy nuclei.

113 pages. \$2.00. Mic 57-2193

COLLECTIVE MOTIONS ON ATOMIC NUCLEI
BY THE METHOD OF GENERATOR COORDINATES

(Publication No. 20,117)

James J. Griffin, Ph.D.
Princeton University, 1955

The developments in nuclear physics which lead one to seek a theoretical model capable of describing both liquid drop and independent particle behaviour are outlined. Various attempts at such a unification are noted; in particular the approach of Aage Bohr is discussed and contrasted with the variational "Method of Generator Coordinates" first proposed by Hill and Wheeler.

The Method of Generator Coordinates is discussed in detail. The form of the combined nucleonic-collective wave function is indicated and its sufficiency for a description of both independent particle excitation and collective excitation is established. Possible objections to the combined wave function are discussed. The variational procedure is carried out formally to obtain the collective integral, or "Generator Equation."

The significance of integral operators like those which occur in the generator equation is discussed in terms of velocity dependent forces. The general nature of the kernels of the generator equation is studied; this study indicates that an equilibrium point exists (for stable nuclei), and that this equilibrium point is a saddle point of the surface describing the ratio of Hamiltonian kernel and the overlap kernel. It is shown that a quadratic approximation to the surface near this equilibrium point results in a soluble generator equation which is related to the ordinary harmonic oscillator equation. The solutions are obtained together with expressions for relevant physical quantities in terms of the parameters of the kernels.

A specific calculation is performed for O^{16} . Some discussion is devoted to the selection of the example and the assumptions to be made about the nuclear Hamiltonian. Generator coordinates describing radial dilatations and spheroidal deformations are considered. Formulae are presented for the kernel which results from a Hamiltonian involving monotonic two-body exchange forces. Numerical calculations are performed for two interactions and the quadratic approximation to the resulting saddle surface is made. In this way specific physical predictions are obtained from the model.

The results of the calculation for O^{16} are discussed and it is concluded that the method of generator coordinates gives reasonable predictions in this case. The general implications of the work are also discussed. It is concluded that the method of generator coordinates is physically suitable, mathematically adequate, and practically applicable to the problem of collective vibrations in nuclei.

106 pages. \$2.00. Mic 57-2194

**$N^{14} + \alpha$ DIFFERENTIAL CROSS SECTIONS
AND THEIR INTERPRETATION IN TERMS
OF THE ENERGY LEVELS OF F^{18}**

(Publication No. 21,220)

David Franklin Herring, Ph.D.
The University of Wisconsin, 1957

Supervisor: Professor Hugh T. Richards

The $N^{14} + \alpha$ differential cross sections have been measured for α -particle bombarding energies from 2.0 to 3.8 Mev. A differentially pumped gas scattering chamber was used. The target gas was kept constant to $\pm .002$ mm of Hg by means of a pressure control system. Basically the system consists of a null type photoelectric error detector, an electronic circuit and a gas flow regulating device. The electronic circuit converts the error signal to an electric current which in turn regulates the flow of gas so that the error is reduced. The stability of the system is investigated and the general performance is discussed.

The $N^{14}(\alpha, \alpha)N^{14}$ differential cross section was measured at center-of-mass angles of 170.8° , 140.6° , 125.1° and 91° . Resonances were observed at α -particle bombardings of 2.351 Mev, 2.370 Mev, 2.768 Mev, 2.868 Mev, 2.870 Mev, 3.080 Mev, 3.567 Mev, ~ 3.67 Mev and 3.71 Mev. The levels corresponding to bombarding energies of 2.868 Mev, 3.080 Mev, ~ 3.67 Mev and ~ 3.71 Mev were observed to decay via proton emission to the ground state of O^{17} .

An analysis of the $N^{14}(\alpha, \alpha)N^{14}$ data was undertaken using the Wigner-Eisenbud dispersion formalism. The analysis gave the definite assignments of 1^- and 2^- for the levels corresponding to $E_\alpha(\text{lab}) = 2.870$ Mev and $E_\alpha(\text{lab}) = 3.080$ Mev respectively, and served to place limitations on the total angular momentum and parity of the remaining levels which were observed.

111 pages. \$2.00. Mic 57-2195

DECAY OF Ce^{144} AND Pr^{144}

(Publication No. 21,401)

Robert L. Hickok, Jr., Ph.D.
Rensselaer Polytechnic Institute, 1957

Supervisor: Dr. S. C. Fultz

The beta and gamma spectra from the decay of Ce^{144} and Pr^{144} has been investigated by means of a magnetic lens beta-ray spectrometer and a single channel gamma-ray scintillation spectrometer. For Ce^{144} three partial beta-ray spectra were observed with end-point energies and relative intensities of 184 kev (30%), 245 kev (10%), and 320 kev (60%). Gamma rays and internal conversion lines corresponding to transitions with energies of 54 kev, 80 kev, and 134 kev were also detected. Internal conversion coefficients indicate an M1 multipolarity for the 80 kev and 134 kev transitions and either an M2 or E3 for the 54 kev transition.

Pr^{144} yields three partial beta spectra with end-point energies and relative intensities of 0.90 mev (2%), 2.45 mev (3%), and 3.15 mev (95%). Corresponding gamma rays were also detected but due to their low intensities

and small conversion coefficients no multipolarity assignments could be made. A tentative decay scheme was proposed based on energy considerations and substantiated by beta-gamma and gamma-gamma coincidence measurements.

107 pages. \$2.00. Mic 57-2196

**SCATTERING OF HIGH ENERGY POSITRONS
AND ELECTRONS; LARGE ANGLE PAIR PRODUCTION
BY BREMSSTRAHLUNG**

(Publication No. 20,878)

Richard Carrel Miller, Ph.D.
University of Illinois, 1957

The positron and electron fluxes from Al and Pb targets irradiated by bremsstrahlung have been observed at angles between 22.5° and 75° and energies between 50 and 170 Mev.

The sign of charge, energy, and solid angle are defined by a non-uniform field focussing magnet; a water Cerenkov counter detects the particles. The magnet energy scale has been determined to 1% by the floating wire technique and has been checked against the betatron energy scale. Its fractional momentum interval has been determined to within 2.5% by comparing the 0° counting rate from Al with the theoretically predicted rate. The solid angle has been determined to within 2.5% by comparing the counting rate under conditions of known geometry with that under the experimental conditions.

At 30° the fluxes from Al are shown to agree closely with theory when the (rather small) effects of finite nuclear size are accounted for. The Al $+/-$ ratios imply non-symmetric pair production of large angle electrons and positrons.

At 30° and 60° the fluxes from Pb have been determined to consist of parts linear and quadratic in the target thickness. The former is interpreted as pair production, and the latter as scattered particles originally produced as 0° pairs. The electron scattering, by comparison with Stanford's results, is identified as elastic scattering; the positron scattering, for which comparative data are not available, is assumed to be elastic. The separation into pair production and scattering is extended to other angles by using a smoothing procedure. The following conclusions are indicated. 1) The pair flux and scattering cross sections vary much less rapidly with energy and angle for positrons than for electrons. 2) The slope of the electron scattering squared form factor in the limit of no nuclear screening is consistent with an r.m.s. radius of 5.42×10^{-13} cm for Pb (Born approximation). 3) The energy distribution of pair-produced and scattered electrons is very similar. 4) Such similarity for positrons is not conclusively shown. 5) For a given energy or angle, the Pb $+/-$ ratio becomes equal to unity for nuclear momentum transfers in the neighborhood of 60 Mev/c.

287 pages. \$3.70. Mic 57-2197

NUCLEAR ORIENTATION OF SOME COBALT ISOTOPES IN CERIUM MAGNESIUM NITRATE

(Publication No. 21,454)

Clifford M. Schroeder, Ph.D.
The Ohio State University, 1956

A detailed comparison between calculated and experimentally observed nuclear orientation effects obtained from radioactive cobalt, contained as an impurity in cerium magnesium nitrate, has been carried out for the cases of zero and two hundred gauss polarizing magnetic fields over the adiabatic demagnetization temperature region characteristic of this material. To this end, a method of calculating the nuclear sub-state relative populations was developed and evaluated for two isotopes of interest, cobalt-60 and cobalt-56. These relative populations were then used to calculate the angular distribution of some of the gamma rays of interest which occur in the decay of these isotopes.

The cobalt-60 experiments reported here are in general agreement with similar experiments at other laboratories, and they are also in qualitative agreement with the effects calculated from independent information. The measured angular distribution changes with temperature in the expected direction, but the magnitude of the observed effects is smaller than one calculates. Measurements in a two hundred gauss polarizing field cannot be described at all temperatures with calculated results by using any value of the number ratio of cobalt ions associated with the two magnetic complexes, which are designated as X and Y ions. Zero field measurements are well described by calculations based on a four-to-one ratio of X and Y ion contributions, but this agreement is thought to be fortuitous.

An attenuation of the calculated orientation could be expected if there were a strong interaction between cobalt and cerium ions. To test this, a sample was prepared in which one-half of the cerium was replaced by diamagnetic lanthanum. Orientation effects obtained from this sample in a two hundred gauss polarizing field improved agreement with the calculations. In zero field there was little change from results of the undiluted sample.

Answers to two important problems appear to be necessary for a detailed understanding of the orientation effects obtained with cerium magnesium nitrate: (a) quantitative knowledge of the cerium-cobalt interaction and (b) positive evidence as to the appropriate number ratio of cobalt X and Y ions.

Results of experiments with cobalt-56 show that orientation effects obtained with it are not essentially different in character from those obtained with cobalt-60.

A technique is described for producing single crystals of cerium magnesium nitrate in a spherical form, which is a preferred shape for low temperature experiments. Use of spherical samples eliminates a shape-dependent temperature correction which is required for other sample shapes, in particular for the flat hexagonal crystals usually employed. As a result of this technique, more reliable values of sample temperature can be determined in the demagnetization region, the lowest temperature being about three millidegrees.

An experimental method is given for determining the shape-dependent temperature-correction term to be used on results obtained with the normal flat hexagonal crystals

of this salt. These experiments indicate that a reasonable value for this term is 1.2 millidegrees.

161 pages. \$2.15. Mic 57-2198

α - γ DIRECTIONAL CORRELATION IN Po^{211}

(Publication No. 20,890)

Sidney Singer, Ph.D.
University of Illinois, 1957

The study of the decay of Po^{211} , first by Spiess, and later in more detail by Jentschke, Juveland, and Kinsey, has indicated the possible existence of a Po^{211} high-spin excited state. Since an estimate of the spin of this state depends directly on the value of the ground state spin, an attempt has been made to learn more about the ground state spin by measuring the two α - γ directional correlations which are initiated by the weak α -decay branches into the 0.569 Mev and 0.90 Mev levels of Pb^{207} . In the interpretation of the experimental data, the following basic assumptions were made: (1) No perturbation of the correlations existed. The small value ($0.7 \times 10^{-24} \text{ cm}^2$) of the Pb^{207} intrinsic quadrupole moment, as compared to values of 10^{-23} cm^2 for the very heavy nuclei where perturbations are observed, supports this assumption. (2) The E2 admixture in the (predominantly M1) 0.90 Mev Pb^{207} decay was not more than 1%. This follows from a study of the results of the directional correlations encountered in the decay of Bi^{207} .

Perhaps the most serious difficulty was that in handling the problem of angular momentum mixing in the α -decay. For each trial spin of Po^{211} , it was possible to find a set of values of the mixing ratios which made the theoretical correlation function agree with the experimental result. On this basis, spins of 3/2, 5/2, 7/2, 9/2, and 11/2 are allowed. A spin of 1/2 ($\text{Pb}^{207} + \alpha$ -particle), however, is definitely ruled out. If, next, the classification of first-forbidden, spin change 0, ± 1 is accepted for the β decays $\text{Bi}^{211} \rightarrow \text{Po}^{211}$ and $\text{At}^{211} \rightarrow \text{Po}^{211}$, then the spins 3/2 and 5/2 can be ruled out (it is assumed that the shell model prediction of equal spins for the nuclei Bi^{209} , Bi^{211} , and At^{211} is correct). In an attempt to differentiate between the remaining choices for the Po^{211} spin, the α -particle mixing ratios were calculated from the α -decay theories of Devaney, and of Thomas. It was found that for any choice of the Po^{211} spin, the experimental mixing ratios were much larger than those predicted from the theories; neither theory was able to adequately describe both correlations. However, if one were to accept as the " Po^{211} spin" that spin for which the agreement between the theoretical and experimental mixing ratios is least unsatisfactory, then one would obtain a value of 9/2 for the Po^{211} ground state spin.

It should be emphasized that the latter conclusion is a very tentative one because of the serious disagreement between the experimental and theoretical mixing ratios. In the event that the Po^{211} spin can be measured by an independent method, the values of the α -particle mixing ratios obtained from this experiment could be used to provide further insight into the nature of the α -decay process.

109 pages. \$2.00. Mic 57-2199

DEUTERON-INDUCED REACTIONS IN NITROGEN AND HELIUM

(Publication No. 21,020)

Ernest Keeling Warburton, Ph.D.
University of Pittsburgh, 1957

An investigation was undertaken of reactions induced in N^{14} , N^{15} , and He^4 by 14.8 Mev deuterons. Observations were made of the proton and triton groups from $N^{14} + d$, the proton and alpha-particle groups from $N^{15} + d$, and the proton group from $He^4 + d$.

All the reactions were studied using gas targets. Gas target chambers were designed to allow observations on reactions particle groups at scattering angles from zero to 90 degrees. Absolute differential cross sections were obtained for all transitions observed by comparison with the accurately known differential cross section for the scattering of deuterons by hydrogen.

Angular distributions and stripping reduced widths were obtained for (d,p) reactions. The stripping reduced widths and the results of the angular distributions were compared with the results of other experiments and with the predictions of theory.

Proton groups were observed from the $N^{15}(d,p)N^{16}$ reaction corresponding to previously unreported levels in N^{16} at $3.53 \pm .03$, $3.980 \pm .02$, $4.80 \pm .05$, $5.01 \pm .05$, and $5.25 \pm .05$ Mev excitation. 89 pages. \$2.00. Mic 57-2200

PROTON COMPTON EFFECT FOR 190 TO 280 MEV PHOTONS

(Publication No. 20,900)

Taketora Yamagata, Ph.D.
University of Illinois, 1957

Elastic scattering of photons by protons, called proton Compton effect, has been investigated for photons with energies from 190 to 280 Mev. A liquid hydrogen target was bombarded by the bremsstrahlung beam from the 300 Mev betatron at the University of Illinois. Recoiling protons were selected in energy by an analyzing magnet and detected by thin and thick scintillation counters. The scattered photons were observed by a lead glass Cerenkov counter working as a total absorption spectrometer. Cerenkov pulses and the two proton pulses were displayed on an oscilloscope. These were photographed and analyzed with respect to the proper time delays and pulse-height distributions in each of the counters.

The main difficulty of the experiment arises from neutral photopions which subsequently decay to two photons and produce photon-proton pairs with a cross section 100 times as large as that of Compton effect. This background was eliminated completely by measuring Compton scattering for photons in the upper part of the bremsstrahlung spectrum. The difference in the recoil proton energy between the two processes was used to discriminate against the neutral pion recoils by setting the magnet so that only Compton recoils could reach the proton counters.

The observed CMS cross sections at 90° CMS, in units of $(e^2/Mc^2)^2 = 2.35 \times 10^{-32}$ cm²/ster, were $.8 \pm .1$, $1.4 \pm .3$, $2.8 \pm .3$, $3.4 \pm .4$, $5.5 \pm .6$, 7.1 ± 1.8 , $5.4 \pm .7$ and 7.4 ± 2.0 ,

at 193, 213, 239, 244, 262, 267, 276 and 282 Mev respectively; at 130° $1.5 \pm .4$ and $5.1 \pm .5$ at 197 and 239 Mev; and at 70° $2.2 \pm .2$ at 230 Mev.

The experimental result was compared with that expected from the Thomson scattering amplitudes combined with that due to the strong magnetic dipole resonance.¹ It was found that the experimental values lie below the calculated curve in the region below 240 Mev and rise up more steeply than the calculated curve at higher energies. This deviation could be accounted for semiquantitatively by means of an electric dipole amplitude obtained from a dispersion relation.²

Using the same equipment, the neutral pion photoproduction cross section was measured. The observed CMS cross sections at 75° CMS, in units of 10^{-30} cm²/ster, were $6.6 \pm .5$, 9.0 ± 1.6 , $10.0 \pm .5$, $12.1 \pm .5$ and $17.3 \pm .8$ at 231, 234, 242, 257 and 272 Mev; and at 120° $2.9 \pm .7$ and $5.1 \pm .4$ at 205 and 238 Mev, respectively, in good agreement with those adopted by Watson et al.³

In the appendix to the paper, the shower process in a Cerenkov counter is investigated using the Monte Carlo method.⁴ The pulse height distribution due to fluctuations in the total electron path length was calculated for several energies (50 to 1000 Mev) and several counter thicknesses (2 to 40 radiation lengths). 214 pages. \$2.80. Mic 57-2201

1. Y. Yamaguchi, to be published.

2. Gell-Mann, Goldberger and Thirring, Phys. Rev. 95, 1612 (1954).

3. Watson, Keck, Tollestrup and Walker, Phys. Rev. 101, 1159 (1956).

4. R. R. Wilson, Phys. Rev. 86, 261 (1952).

RADIOACTIVITY OF SOME OF THE LIGHTER ELEMENTS

(Publication No. 21,504)

Akihiko Yokosawa, Ph.D.
The Ohio State University, 1957

(1) Titanium 51

Sources prepared from the products of a $Cr^{54} + n$ bombardment were found to exhibit an activity with a period of 76 ± 2 days half-life, involving the emission of gamma rays of energies 75, 315, 470, 625, 785, and 940 Kev, and β^- of 650 Kev.

These six gamma rays were also observed in samples prepared from the products of a $Ti^{50} + n$ bombardment and were found to have the same relative intensities as those of $Cr^{54} + n$. The sum lines of gamma rays, observed in the sample of $Cr^{54} + n$, by the total absorption gamma-ray spectrometer are also in agreement with those of $Ti^{50} + n$.

Therefore, the resulting activities were considered to be $Ti^{50}(n,\gamma)Ti^{51}$ and $Cr^{54}(n,\alpha)Ti^{51}$.

Chemical separations showed the activities from $Cr^{54} + n$ sources to be associated with manganese; however, the decay scheme obtained is entirely different from that of Mn^{56} . The 76-day activity is not considered to be an isomer of Mn^{56} . According to the chemical procedures employed in this separation, the MnO_2 fraction might include TiO_2 , which is not expected to be in the cobalt, chromium, and iron fractions.

In view of the foregoing considerations, it is highly possible that the 76-day activity is a long-lived isomer of Ti^{51} . This proposal is also supported by the fact that the main part of the decay scheme is in excellent agreement with that of 5.8-minute Ti^{51} .

Antimony, calcium, hafnium, and tantalum were reported as impurities in titanium. The decay scheme and half-life of the proposed long-lived isomer of Ti^{51} are in disagreement with those of these impurities. According to the beryllium absorption test on the products of $Ti^{50} + n$, a value of K-xray energy was 5.8 Kev, which falls near the manganese $K\alpha$ line.

(2) Manganese 53

It seemed probable that manganese 53 would have a very long half-life. A $Cr^{50} + \alpha$ bombardment was performed to produce manganese 53, and the chemical separations and gamma-ray measurements showed both a 16-day manganese activity with 600 Kev beta- and 1.40 Mev gamma-energies and a 320-day Mn^{54} . After further chemical separations and coincidence measurements, the activity was found to be due to V^{48} .

It is concluded that there is no Mn^{53} activity in the half-life regions from 24 hours to 400 days. The existence of Mn^{54} made it difficult to identify a reported 140-year Mn^{53} . However, the decay of the manganese fraction was followed for 15 months.

The decay experiments show a 350 day half-life with an aluminum absorber and 470 days without, indicating that Mn^{53} has a long half-life and decays only by K-capture. The gamma rays of the manganese fraction from the $Cr^{50} + \alpha$ source were studied by the total absorption gamma-ray spectrometer, and no activities were observed except 840 Kev which could be attributed to Mn^{54} . According to the beta-spectrometer, 180° deflection type, no positrons were observed.

(3) Boron 13

B^{13} may be expected to have a measurably long half-life, since the neutron number of B^{13} is 8. A neutron bombardment of boron and lithium borate was done under the assumption that a (t,p) reaction of lithium borate and/or double neutron capture by B^{11} might produce B^{13} . Neutron irradiation of carbon was also performed in an attempt to produce B^{13} by an (n,p) reaction.

Boron fractions from lithium borate + n and C + n showed a very weak activity in comparison with those of the original sample.

It is concluded that no activity corresponding to B^{13} with a half-life of 15 hours to approximately 200 days was observed in the products of lithium borate + n, boric acid + n, and C + n.

114 pages. \$2.00. Mic 57-2202

PHYSICS, SOLID STATE

THE ELASTIC CONSTANTS OF MAGNESIUM ALLOYS

(Publication No. 20,942)

Thomas R. Long, Ph.D.

Case Institute of Technology, 1956

The adiabatic elastic constants of single crystals of magnesium and dilute alloys of magnesium with Ag, In and Sn have been measured by the ultrasonic pulse echo technique. The values obtained for pure magnesium are: $C_{11} = .597$, $C_{33} = .617$, $C_{44} = .164$, $C_{12} = .262$, $C_{13} = .217$ all expressed in units of 10^{12} dyne cm^{-2} . The alloy results show that all constants exhibit a smooth behaviour as the electron concentration is increased to 2.020 per atom, through the critical region where zone overlap is thought to occur in the c direction. This behaviour is in contrast to what might be expected from an extension of Leigh's predictions for the elastic constants of aluminum alloys.

29 pages. \$2.00. Mic 57-2203

PHYSIOLOGY

EFFECTS OF EXPERIMENTAL JAUNDICE ON ADRENAL CORTICAL ACTIVITY IN RATS

(Publication No. 21,047)

William Prentice Baker, Ph.D.

Michigan State University, 1955

1. Experimental jaundice was produced in rats by ligating the common bile duct. The effects of the resulting jaundice on adrenal cortical activity, adrenal function and liver inactivation of hydrocortisone (compound "F") were studied.

2. Ligation of the common bile duct of rats resulted in a marked increase in the icteric index of the plasma. The average icteric index reached a maximum of 47 on the fifth post-operative day and then declined slowly due to the recovery of some of the animals. The icteric index

was found to average only 3.9 in normal control rats. Gross and microscopic changes typical of obstructive jaundice were seen in the rats made jaundiced by this procedure.

3. Twenty-four male rats were used in an experiment to determine the effects of experimental jaundice on adrenal cortical activity. On the eighth day following bile duct ligation the animals were autopsied and it was found that the thymus of the jaundiced rats had undergone marked involution. This effect could not be attributed to the surgery or reduced food consumption since a sham-operated, pair-fed group of rats failed to show thymic involution. It was noted however, that jaundice was accompanied by decreases in food consumption and body weight. There was no significant difference in the weight of the adrenals between the jaundiced and non-jaundiced rats.

4. In another experiment, thirty rats were made

jaundiced and were sacrificed on the sixth post-operative day. Three 4.5-6.0 mg. cotton pellets were implanted subcutaneously in each of the rats at the time of bile duct ligation or sham-operation. These pellets plus the granuloma formed around the cotton were removed and weighed at the time of sacrifice. In addition, the thymus, liver, and adrenals were weighed and the adrenal ascorbic acid was determined. Reduced granuloma formation and a decrease in thymus weight were found in the jaundiced rats but not in the sham-operated, pair-fed controls. There was increased liver weight in the icteric rats but no significant difference occurred between the adrenals ascorbic acid levels of the jaundiced and non-jaundiced animals.

5. Thirty male rats were used in another experiment to determine whether or not a functional adrenal cortex was required for the previously observed effects of jaundice on thymus weight and granuloma formation. Some of the rats which were both adrenalectomized and jaundiced succumbed, making the data somewhat difficult to interpret accurately. It was observed however, that thymus involution and granuloma inhibition did not occur in the jaundiced rats which were adrenalectomized. This suggests that a functional adrenal cortex is required for the increase in adrenal cortical activity seen in experimental jaundice in rats.

6. The effects of experimental jaundice on the survival of adrenalectomized rats given a single dose of compound "F" was studied in forty mature rats. These rats were given a large dose of compound "F" just prior to adrenalectomy. In addition, the common bile ducts of some of the animals were ligated. It was observed that the jaundiced adrenalectomized rats given compound "F" did not survive as long as the similarly treated non-jaundiced animals. It was concluded that jaundice probably does not interfere with the inactivation or excretion of this adrenal steroid. An increased utilization of the adrenal steroids may be indicated.

7. An experiment was performed on sixteen rats to determine whether or not experimental jaundice affects the *in vitro* inactivation of hydrocortisone (compound "F") by surviving liver slices. Eight of these rats were made icteric by ligation of the common bile duct. The remaining eight animals were sham-operated and pair-fed to the jaundiced group. On the sixth post-operative day the rats were sacrificed, the livers removed, and liver slices were prepared with a razor blade. Slices from each of the sixteen livers were incubated for three hours in Ringers' solution containing a known quantity of compound "F". Following this incubation period, the remaining compound "F" was extracted and determined chemically (by paper chromatography) and by means of biological assay based on thymic involution. The chemical analysis showed that icteric and non-icteric liver slices inactivated similar quantities of compound "F". The biological assay showed that a large quantity of compound "F" was inactivated by both the jaundiced and non-jaundiced liver and that the effects of both on thymus weight were similarly negative. It was concluded that experimental jaundice does not result in decreased inactivation of this adrenal cortical hormone.

8. It is suggested that thymic involution and reduced granuloma formation in rats and perhaps the disappearance of arthritic symptoms in jaundiced human patients are brought about by increased sensitivity of the body tissues to adrenal steroids or to other mechanisms not yet determined.

83 pages. \$2.00. Mic 57-2204

THE COMPOSITION OF THE BODY AND ITS ESTIMATION BY INDIRECT METHODS

(Publication No. 21,251)

Jose Mendez, Ph.D.
University of Minnesota, 1957

Major Adviser: Ancel Keys

The density of muscle was determined applying the Archimidean principles of hydrostatics. Dog and rabbit muscles were weighed in air and underwater, and the volumes were obtained by determining the volume of water displaced during submersion. The average density of muscle was found to be 1.0596 ± 0.0017 .

The chemical composition of the muscle whose densities were studied was determined using standard methods of analysis. Water, fat, protein, and ash content were obtained for each individual sample.

The coefficient of thermal expansion of muscle was calculated by determining the density at two different temperatures. It was found to be 3.5×10^{-4} . This coefficient was used to correct the muscle density to body temperature.

The density of fat extracted from different tissues was studied employing a pycnometric method. The densities of muscle and brain fats were shown to be significantly higher than the densities of adipose tissue and bone marrow fats. The bone marrow fat showed a similar density to adipose tissue fat. The thermal coefficients of expansion of the different fats were determined and all the densities were corrected to 37°C . The difference in densities was shown to be due to the chemical composition of the fats. The steroid and phospholipid content was investigated. The significance of the difference in fat densities for body composition computations is discussed. It was concluded that the use of the value of 0.900 at 37°C for the density of fat should be continued until a method is found for the estimation *in vivo* of the different fat fractions.

The bone mineral was found to have a density between 2.96 and 3.00. It was estimated that the value of 3.00 generally used for the density of bone mineral in the computation of body composition is correct. The amount of ash of the bone mineral was estimated to be between 95.2 and 96.5 percent. These figures were suggested to be of some value in the estimation of bone mineral from the ash content given in the cadaver analysis.

From the density and chemical composition of muscle, and the density of the different components, the density of the "Fat-Free Cells" was estimated to be 1.0741 ± 0.0019 and the density of the "Fat-Free Cell Solids," 1.3924 ± 0.0068 . The basic concept of tissue made up of "Fat-Free Cells" and additive products, as fat and bone mineral, is discussed.

The composition of the "Reference Man" of the Minnesota System was calculated on the basis of the density of the "Fat-Free Cells" and was found to be as follows expressed in percent of body weight: Fat, 18.38; Bone Mineral, 5.71; Extracellular Fluid, 16.00; and Fat-Free Cells, 59.91. The Total Water was 59.80 and the Fat-Free Cell Solids, 16.11 percent.

The density of the "Fat-Free Body Mass" was calculated from the composition of the "Reference Man" and the density of the components as 1.108. In the same way the density of the "Fat-Free Body Solids" was calculated as 1.621.

The composition of the "Obesity Tissue" studied by Keys et al was calculated on the basis of the density of the "Fat-Free Cells." This tissue was found to have the following composition expressed in percentage of total tissue: Fat, 63.5, Extracellular Fluid, 14.0; and "Fat-Free Cells," 22.5. The Total Water was found to be 30.3 and the "Fat-Free Cell Solids," 6.2 percent.

The common working equations for the determination of body fat were revised using the collected data presented in this dissertation. 162 pages. \$2.15. Mic 57-2205

AN ELECTRICAL STUDY OF THE NEUROMUSCULAR JUNCTION WITH SPECIFIC REFERENCE TO EFFECTS FROM CARBON DIOXIDE

(Publication No. 21,361)

William Waldron Steinberger, Ph.D.
University of Michigan, 1956

Focal type of electrical recordings were made from a frog's (*Rana Pipiens*) sartorius nerve-muscle preparation. Effects from curare, prostigmine, and changes in stimulus strength and frequency all correlated well with other workers. Application of carbon dioxide gas mixtures to produce changes in tissue acidity gave reduced end-plate potentials which were contrary to effects reported by Gesell et al for the central nervous system. Since carbon dioxide is known to have a blocking action on nerve conduction another method of electrical recording was devised. By placing the active recording electrode on the nerve just adjacent to the muscle and leaving the indifferent electrode on the tendonous end of the muscle a composite potential having three identifiable components was obtained. The first electrical component was due to direct tissue conduction of the stimulus and was followed at a reasonable conduction time interval by an electrical potential shown to be related to the passage of the nerve action potential. The third electrical wave was shown to be similar to a focal type recording of the end-plate potential.

Separation and identification of the waves were shown by changing the strength of stimuli, tissue level of curare, and by tissue dysfunction produced by application of ethyl alcohol. The recording method is of value because it permits observing both the nerve action potential and end-plate potential it elicits. It is significant that the end-plate potentials can be remotely recorded.

Re-investigation of the carbon dioxide application to the sartorius nerve-muscle preparation with this recording method showed a maintained nerve action potential at the point where the nerve enters the muscle, and a decreased end-plate potential. Application of oxygen brought about a recovery of the end-plate potential. This reduced end-plate potential for the sartorius preparation was in agreement with a similar effect reported by Finerty and Gesell. Those experiments recorded an evoked muscle contraction from stimulation by acetylcholine in the bathing solution. Introducing acid to the solution effected a reduction of the mechanical contraction produced by the acetylcholine when using muscles of locomotion (i.e. sartorius). With muscles related to respiration (i.e. rectus abdominus) they found an increase in the response when the bathing solution was made acid. Recordings with the electrode placement described above showed with carbon dioxide application to the rectus nerve-muscle preparation the decreased end-plate potentials similar to the results obtained with the sartorius preparation. Some facilitation of the end-plate potential during the carbon dioxide application was noted at the stimulation frequencies of 30 per second with the rectus abdominus preparation.

The results would indicate that at least at the point where the nerve enters the muscle the nerve action potential seems adequate to give the normal end-plate potential. Reduction of the end-plate potential indicates an action of carbon dioxide in this system more dominant than a possible acid anti-cholinesterase activity. The slight facilitation may indicate some possible anti-cholinesterase activity. 105 pages. \$2.00. Mic 57-2206

POLITICAL SCIENCE

POLITICAL SCIENCE, GENERAL

THE GOVERNMENT OF OKAYAMA PREFECTURE: A CASE STUDY OF LOCAL AUTONOMY IN JAPAN

(Publication No 21,152)

Cecil Carter Brett, Ph D
University of Michigan, 1956

What have been the effects of the political reforms introduced into Japan by the Allied Occupation? This study attempts a partial answer to this question. It examines present day practices in the government of the prefecture of Okayama, Japan. Its object is to discover the extent to which the Occupation sponsored decentralization and democratization measures have been carried into practice in this single unit of government.

The post war political reforms sought to establish local self government through (1) decentralization -- the transfer of political and administrative power from central to local authorities and (2) democratization -- the bringing of administrative functions under the will of the local community by means of direct popular controls, an elected executive and a strengthened legislature. An elaborate legal structure was set up to implement these measures and this became the framework of the new local government system. (Chapter I). The body of the study begins with a general survey of the organization and operation of the Okayama prefectural government. (Chapter II). There follows a more detailed consideration of the executive (Chapter III) and of the legislature (Chapter IV). The informal and extra legal methods by which law making actually takes place are examined in Chapter V. Chapters VI and VII deal with national-prefectural relations with reference to three specific functions of government -- agriculture, education and police. The focus of attention throughout is upon the present day application of the local self government reforms. The data for this study were gathered by the use of field research techniques -- daily direct observation over a period of a year, interviews, questionnaires and examination of relevant documents.

Examination of the functioning of the executive and legislative branches shows that the popular controls established by law over the prefectural administration have been only partially successful in practice. The initiative referendum and recall so far have not been used. The legislature, despite its new legal status and powers, remains in a position subordinate to the executive and functions mainly in an advisory capacity. The officials of the executive branch still retain, unchallenged, their preeminent status of former days. Although they are no longer national civil servants they are still, in an extra legal sense, a part of the central bureaucracy. The most significant of the reform innovations has been the elected executive. The elected governor today represents prefectural interests as distinct from national interests. But the governor, in the exercise of his administrative functions, serves the central government rather than the prefecture.

The laws and policies which he executes are made not in Okayama but in Tokyo. Little scope is left for the exercise of prefectural initiative. National control over the prefecture by means of legislation and ministerial supervision is steadily increasing. Central encroachment upon prefectural autonomy has met with little apparent resistance. The power of the central government is further strengthened -- and that of the prefecture weakened -- by the operation of the national subsidy.

Two general conclusions can be drawn from this study. One is that the local self government reforms, in the governmental unit studied, have fallen far short of expectations. Decentralization has given way to centralization. Democratization, with the notable exception of the elective governor, has miscarried by default. Local autonomy in practice has been reduced to the administration of central laws and policies by a locally elected executive. Another conclusion which emerges from this study is that prefectural government still retains its hierarchical bureaucratic character. Moreover, the traditional authoritarian habits of thought and action are very much in evidence.

305 pages. \$3.95. Mic 57-2207

OSWALD GARRISON VILLARD: A STUDY IN AMERICAN LIBERALISM, 1918-1932 (PARTS I-III)

(Publication No. 18,019)

Dollena Joy Humes, Ph.D.
Syracuse University, 1956

The history of American liberalism is generally understood to be a story of spasmodic development; of occasional retrogressions and surges of energy. So, too, has there been general agreement that the years 1918-1932 covered one of liberalism's periodic declines. Each wave of liberalism has been viewed as raising different fundamental issues and consequently as meaning different things at different times. Thus liberalism has been described as erratic and unsystematic in development, and essentially fluid and frequently elusive in doctrine.

This study undertakes to demonstrate, through a presentation and analysis of the writings and activities of Oswald Garrison Villard, that the period of the nineteen-twenties was not devoid of liberalism; that, indeed, those years provided personnel and program which nurtured the philosophy and method of recent American liberalism throughout an era which saw that movement on the wane; that, in reality, the period formed a link between the more concrete and articulate liberal movements known as "Progressive" and "New Deal." The broader thesis and the conclusion reached is that, contrary to the opinion held by some scholars, the American liberal movement of the twentieth century has lacked neither continuity nor philosophic consistency.

The method of approach used herein rests on the assumption that a political philosophy in the abstract is incomplete; that its concrete manifestations become clearer through an analysis of some actual historical figure who attempted to translate theory into practice. The figure chosen as representative of American liberalism in the nineteen-twenties is Oswald Garrison Villard.

This study is not a biography although biographical details are utilized to illustrate Villard's philosophy and activities on behalf of liberalism. Neither is it intended as a history of the period but rather a study of some of the principle strands of American liberalism in a period of cynicism, disillusionment and reaction. As such it could not avoid history, for political theory does not and should not develop external to the realities of the world with which it deals.

Oswald Garrison Villard stoutly supported traditional American liberties. He fought vigorously both state and national espionage and sedition laws; crusaded zealously against the intolerance and super-patriotism of the twenties which found all dissenters subversive; sought persistently to enlarge the scope of criminal justice; urged an extension of individual rights and equal opportunity and protection to minority and under-privileged groups; for example, Negroes, women, American Indians, immigrants, religious groups, industrial wage earners.

Villard assumed a pragmatic approach to social institutions which led him to advocate experimentation and the rejection or modification of those institutions which proved ineffective in meeting human needs. To attain more responsive and responsible political institutions, he fought corruption and special interests, advocated the initiative, recall, referendum, direct primary, and an effective opposition party.

Villard's pragmatism applied to the economic realm resulted in the conclusion that the free enterprise system was in need of modification; that such was the task of a political authority responsive and responsible to the people. He opposed government subsidies; encouraged legislation designed to curb and regulate the great economic trusts, holding companies and monopolies; advocated government ownership and operation of railroads, the nation's natural resources, and general utilities.

Extended to the international sphere, Villard's liberalism embraced the advocacy of self-determination of nations, peaceful methods of settling international disputes, pacifism and disarmament, and also opposition to economic imperialism.

In the writings and activities of Oswald Garrison Villard, can be discerned the basic pattern of recent American liberalism--tolerance, pacifism, rationalism, pragmatism, anti-imperialism, humanitarianism, internationalism, individualism, experimentation--his work constitutes a "mosaic" in the history of the American liberal tradition.

425 pages. \$5.45. Mic 57-2208

THE APPOINTMENT AND DUTIES OF NOTARIES PUBLIC IN THE UNITED STATES (PARTS I AND II)

(Publication No. 18,031)

Charles Joseph Meder, D.S.S.
Syracuse University, 1956

Little has been written concerning the appointment and duties of notaries in the United States for the office of notary public is considered to be a relatively minor office. It is supposed by many that the witnessing of a document by a notary public is a mere legal formality stemming from custom long established by the commercial world. As a result of such indifference admission to the notarial office is often a comparatively simple matter. In most states a person who is a resident of the state, a citizen of the United States and who is twenty-one years of age is eligible for appointment by the governor as a notary public.

Research conducted on the problem of discovering just what the provisions of the various states are relating to the appointment and duties of notaries has brought forth some interesting disclosures. These disclosures result from an intense study of statutes, case material and administrative rulings as applied to notaries public.

In reference to appointment it may be noted that in the District of Columbia, Louisiana, New York and Ohio a notary is not appointed to office until he has successfully passed a written or oral examination concerning the duties of his office, and in seven states a notary is not commissioned until the appointment by the governor is ratified by the state legislative body.

A study of the duties of notaries reveals that a notary's duties are not always confined to the taking of affidavits, acknowledgements and depositions. Over half the states confer on the notary subpoena power and in three of these states both the statutes and the courts empower a notary to punish for contempt those who fail to obey his subpoena or who appear contumacious by refusing to answer questions or be sworn in his presence. In Florida and in Maine a notary may solemnize a marriage ceremony, and in Virginia and West Virginia a notary public is a conservator of the peace, and as such possesses all the power of a justice of the peace in acting to prevent a breach of the peace.

But even in states where a notary does not possess such important judicial or quasi-judicial powers the common, ordinary acts usually associated with the notarial office such as affidavits, acknowledgements and depositions often prove to be of vital importance to the parties thereto, for upon the fidelity, integrity and ability of a notary does security to a title often rest. When legislators are made to realize this it may be that one day an examination may be required of notarial applicants in nearly all of the states, and then it will be at least as difficult, if not more, to secure appointment as a notary public as it is to obtain a barber's license. 331 pages. \$4.25. Mic 57-2209

HOSPITAL LIABILITY IN THE UNITED STATES (PARTS I AND II)

(Publication No. 19,388)

Palmer Clyde Pilcher, Ph.D.
Syracuse University, 1956

In general scope this dissertation is the study of the trust fund doctrine as it has conditioned and been conditioned by judicial conceptions of public policy relative to voluntary hospitals in the United States. It is assumed that in order to fully comprehend the development of contemporary doctrines, attention must be directed to the historical emergence of the problem abroad.

For purpose of analysis and clarification, the study has been divided into two parts. Part I deals with the historical development of hospitals and the trust fund as concept in both England and America. The various avenues of escape from fiduciary responsibility for wrong, following an analysis of tort, in a society based in great part upon due process are included. Accordingly the public policy, implied waiver and respondeat superior doctrines as developed by judicial bodies are analysed.

Part II is a state by state summation of adherence to the various theories of immunity ranging through relatively full liability of hospitals for injuries to patients. The categories within which the respective states are placed do not follow the classic exemptions as treated in Part I. This is occasioned by the fact that the various states in adopting degrees of liability or immunity have in great part developed, since the first Massachusetts case, patterns of exemption peculiarly American. These are judicially determined norms which include the theories of Part I but with a unique total construction needful of observation. Accordingly, this second portion treats each state that has had before its senior court for determination, the problem of eleemosynary institutional liability. The states are treated in sequential pattern showing the emergence of the problem in each state through the case of first impression and following the evolution of the doctrine in that state to its most recent conclusion.

The source material for this study consists in the main of judicial decisions. Reliance is also made on supplementary sources, particularly those treating with historical development of the hospital as institution in Part I.

In one sense, this is a study of one area of law which may well be one of the last remaining areas of an archaic protective concept that has since its early inception been outlawed in a majority of parallel fields. In particular, reference here is to the workman compensation development in this country and to the exits once commonly employed by employers to escape liability for the injury of their employees. The avenues of avoidance of liability through the old fellow servant, contributory negligence and assumption of risk doctrines have much in common with the categories of immunity from tortious acts still claimed by voluntary institutions in the bulk of the states.

Viewed variously, the study concerns the problem of securing substantive justice for individuals, a problem which to a great degree surmounts what are frequently mistaken as merely legalisms and so problems, by jurisdictional default, for the lawyer rather than the social scientist which are considered to an ultimate purpose of this study.

The state by state analysis points to the obvious

necessity of a study of the better integrated control of hospital services through community organizations. Such a study should direct itself to the changing role of hospitals as independent islands of mercy in a highly individualized culture. By definition, social organization involves disciplined interrelationships and common patterns of justice. It is apparent that the state judicial bodies have not provided these common patterns and that the state legislatures have been reluctant to fill this vacuum of need as well. Hence, there is a need for the emergence of a new pattern of discipline employing the courts, legislatures, professional associations and community organizations out of which synthesis, new and uniform norms may emerge. It has been the purpose of this study to point out that judicial controls are but one of components in this needed composite system. 277 pages. \$3.60. Mic 57-2210

HAROLD J. LASKI, FROM PLURALISM TO MARXISM

(Publication No. 21,213)

Robert Yee, Ph.D.
University of Washington, 1957

This dissertation is a study of Harold J. Laski as a pluralist and his later acceptance of Marxism. As such, it points out the unresolved difficulties between his advocacy of pluralism and his faith in the autonomous individual. It attempts to show that it is these difficulties, and the historical events of the early 1930's, which led to Laski's acceptance of the Marxist framework.

In the 1920's, Laski embraced an admixture of individualism and pluralism. In his individualism, he stressed the uniqueness of personality and the importance of individual conscience developed through the exercise of individual judgment based upon personal experience. His individualism was akin to anarchy to the extent that he emphasized the right and duty of every individual to follow the dictates of individual conscience even though it might "break the heart of the world."

On the other hand, Laski's pluralism stressed the importance of groups in society as the vehicle for the intellectual growth of individual personality. He emphasized the independence of groups from one another and their equality of moral status. Individuals were to retain their separate identities while moving in and out of groups as their individual judgment directed.

No attempt was made during this period to reconcile his thorough-going individualism with the implicit limitations which would be imposed upon such an individualism were his pluralism to be a viable philosophical position. In failing to reconcile the dilemma posed by advocating both individualism and pluralism, Laski as a political theorist, was unable to account for the events of the early 1930's which, to him, demonstrated the denial of the process of reasoned discussion in political affairs and the failure of his pluralism to be truly representative of the social order.

His turning to the economic determinism and the doctrine of class struggle of Marxism, rationalized individual behavior and provided, for Laski, the scheme by which the pluralism of the earlier Laski would ultimately become a reality. In so doing, he sacrificed his liberal emphasis

upon the integrity of personality and placed his faith in the coming of an ideal classless society.

153 pages. \$2.05. Mic 57-2211

POLITICAL SCIENCE, INTERNATIONAL LAW AND RELATIONS

POPULATION GROWTH IN CEYLON

(Publication No. 20,048)

Earl E. Huyck, Ph.D.

The American University, 1956

Rapidly declining mortality but continuing high fertility in the postwar period aroused interest in Ceylon as a "demographic laboratory." The present study fills a gap in the growing demographic literature concerning mainland and insular Asia. It considers the setting (geographic and climatic environment, historical background, and economic pattern); population distribution (settlement pattern and ethnic composition); population dynamics (mortality, fertility, external and internal migration); and concludes with a discussion of problems and prospects.

The Ceylonese population (8.6 millions in mid-1955) is increasing at the average annual rate of 2.8 percent, which is one of the highest rates of growth in the world. This is a development of the past decade. From the 1830's to the 1930's external migration played a substantial role when the British introduced large numbers of Indian Tamil families to provide the labor force for mountainous coffee and tea estates. Other Indian Tamils and Moors came to Colombo as unskilled laborers and trader-merchants.

The economic depression of the 1930's stimulated the passage of legislation by both Ceylon and India restricting the flow of migrants. In the postwar period demographic pressures within the estates, already expanded to the limits afforded by topography and climate, have both mitigated against the recruitment of additional immigrants and stimulated the movement to retire resident Indian Tamils to "the coast" sooner. Relatively few Indian Tamils have been granted citizenship status. Demographic pressures in the present agricultural villages have concurrently generated political pressures for the alienation of estate land and may ultimately mean the nationalization of the estates. These factors point to a continuing return migration to India such as has occurred since the 1930's.

In the past, mortality has shown a pattern of periodic peaks simultaneously with the outbreak of malaria epidemics related to monsoon failure. For centuries endemic malaria afflicted the northern, eastern, and southeastern portions of the island. At best it debilitated the populace and at worst snuffed out countless lives, particularly of infants, children, and expectant mothers with the result that it served as a brake upon fertility.

The last major malaria epidemic occurred in 1934-35 and caused an excess of deaths over births. The Government brought under control an incipient outbreak in 1945-46 by using D.D.T. With the virtual elimination of malaria the deathrate dropped precipitately from 22.0 in 1945 to

to 14.3 in 1947 and to the Western level of 10.9 deaths per thousand population by 1953.

Fertility nonetheless continues at a high level and has even increased slightly in former malarious areas. In-deed, the major finding of this study is that there has been no sizeable decline in fertility such as indicated in the 1946 Census volumes. When appropriate adjustments were made for differences in age tabulations and for mortality in the various intercensal periods, the child-woman ratios became reasonably consistent with registered births, gross and net reproduction ratios, numbers of children ever born, and with results obtained through the usage of various substitute fertility schedules. All series point generally to continuing high fertility--the birthrate rises to 45 when an allowance is made for the under-registration of births.

Within this overall historical pattern of fertility, however, there have been differentials (urban-rural and ethnic) at any one time coupled with secular fluctuations.

Migration had been controlled by governmental statutes and police measures. Mortality was halved in eight years through the application of advanced technology in the form of insecticides. But fertility is rooted in the family structure predicated upon the necessity for survival to maturity of a sufficient number of children to maintain the family. As such it is more resistant to change and will be the predominant factor determining the future course of population growth in Ceylon. Even on a modest assumption as to the future course of fertility, the population will double in size reaching 18.0 millions by 1995. Whether the Ceylonese will re-align their fertility in view of declining mortality is a question for the Ceylonese themselves to answer. Certainly the problem is in the here and now--if fertility is not reduced consonant with the rapid decline of mortality, population growth will throw human resources further out of balance with the economic resources of the island.

646 pages. \$8.20. Mic 57-2212

THE COMMUNIST PARTY OF GREECE SINCE 1918 (PARTS I-III)

(Publication No. 18,026)

Dimitrios George Kousoulas, Ph.D.

Syracuse University, 1956

The Communist Party of Greece (K K E) has played an important, though not constructive, role in Greek politics, especially during the last two decades. Although at the present time it is outlawed, its influence has by no means eclipsed. During the recent general elections of February 19, 1956, K K E, through its front organization EDA, managed to form a United Front electoral coalition with a number of democratic parties; this coalition mustered more votes--though due to a complicated electoral system it failed to elect more Deputies--than the pro-Western party under Mr. C. Karamanlis. In the framework of the current peace offensive--and especially after the removal of Zachariades from the party leadership last March--one may reasonably expect that the Communist party and its agents will press for the "legalization" of K K E and, at the same time, they will intensify the propagandistic

campaign for "the conquest of the masses". Only an informed public opinion can be sufficiently immune to Communist propaganda. Yet, there is not a single work--Communist or non-Communist--in Greek or in English dealing comprehensively with the history of K K E, its methods of propaganda and agitation, its strategy and tactics, its organization and its objectives. It is hoped that the attached work will provide the general public and the molders of public opinion with a more or less comprehensive picture of the Greek Communist party.

This work has been based almost exclusively on Communist sources of information. K K E has published several collections of party documents, covering the years 1918-1945. Another valuable source was the publications of the Communist International. Certain narratives by former party members were helpful--though written mostly from memory contained many inaccuracies; by correlating the data of various sources many such inaccuracies have been eliminated and the correct dates and events reconstructed. Another useful source was personal interviews of the writer with persons who have played an important role in party and political affairs. The assistance of the Greek Central Intelligence Service (KYP) and of the Greek Ministry of Public Security in obtaining certain documents and information otherwise unavailable was extremely valuable.

The present work covers the years 1918-1945, i.e. since the foundation of the Party till the Varkiza Agreement which marked the end of "the first armed attempt" of K K E to conquer power. It has been divided into three parts preceded by an introduction which deals with the basic features of a Communist party, and with the domestic Greek conditions which help or hinder the spread of Communist ideology in Greece.

Part One, under the general title "The Years of Crisis", deals with the early years, the transformation of the Party from a Socialist to a Communist one, and the successive intra-party crises which lasted until Comintern installed N. Zachariades as the absolute master of the Party (November 1931).

The second Part, under the general title "The 'Monolithic' Party", deals with the organization of K K E as a Stalinist party, and its preparation of the first attempt to conquer power. This attempt never materialized because it was halted by the establishment of the Metaxas Dictatorship (August 4, 1936) "before" the Party had sufficient time to complete its revolutionary preparations.

Part Three, under the title " 'Turning the Imperialist War into a Civil War' ", covers the decade 1936-1945, that is, the disintegration of the Party under the Dictatorship, its reorganization after the occupation of Greece by the Axis, its role in the resistance movement, its first armed attempt to conquer power and the reasons for its failure.

Although this work follows the evolution of the Party through the years, it is not confined to a narration of successive events. Major emphasis has been placed in the study of the party organization, its techniques, and its objectives. 558 pages. \$7.10. Mic 57-2213

PREVAILING CONCEPTS CONCERNING AN INTERNATIONAL DEVELOPMENT AUTHORITY

(Publication No. 21,483)

Leon Charles Lantz, Ph.D.
The Ohio State University, 1957

The failure to extend the Industrial Revolution by exploiting the potentials of science and technology in the underdeveloped areas of the world with inferior economic status is becoming more and more inexplicable in the mid-twentieth century. Furthermore, two-thirds of the world's population, loosely referred to as the "have nots," are becoming progressively more restive and determined to improve their status through positive, constructive action.

One contemplated solution entails the establishment of an International Development Authority to plan, finance, and deliver a concerted and comprehensive attack upon world poverty. In essence, the proposal amounts to an effort to internationalize the burden of underdevelopment. The problem of this investigation is to analyze the political forces and activity surrounding certain individuals, groups, governments, and the international community in relation to their support of, or their opposition to, an International Development Authority (IDA), whether in principle or in actual practice.

During and after World War II, the proposal was endorsed by both governmental and nongovernmental groups. Owing to the achievements and publicity which the United Nations Expanded Program of Technical Assistance and the Point Four Program of the United States had generated from the time they were created in 1949 and 1950 respectively, the underdeveloped nations were successful in having the question of establishing an Authority placed on the agenda of the United Nations. Consequently, the official documents of the United Nations have been used extensively as primary source material in pursuing this project.

In substance, a dichotomy of views between the so-called developed and underdeveloped nations is a distinct and reoccurring theme which permeates the whole study. Both groups were in agreement about the existence of a common problem, but the former group pleaded inability to supply the Authority with the necessary capitalization, which ranged in estimates from one to several billion dollars annually.

Although the proposal for the establishment of an International Development Authority was repudiated by the United Nations in 1951, the developed countries turned most reluctantly to a discussion of a Special United Nations Fund for Economic Development (SUNFED) as an alternative. Unlike IDA, SUNFED would have a predominantly financial function, with an initial capitalization of only \$250,000,000. Nevertheless, a policy which made contributions to a fund contingent upon disarmament savings blocked the advent of SUNFED itself.

Some nations are apprehensive that a truly international agency would exercise powers of assessment and administration contrary to their immediate welfare. The failure of the underdeveloped nations to attain their objective also depicts, in reality, a structural deficiency of the United Nations, i.e., it is merely a facade for the actual distribution and disposition of political power.

Meanwhile, prominent individuals and many organized groups throughout the world continue to extend their

unqualified endorsement of the concept fundamental to an Authority. Many, however, are reconciled to the eventual adoption of SUNFED as an evolutionary step toward IDA. On the constructive side of the political process, the cause of the underdeveloped countries has benefited from the world-wide publicity concerning the gigantic task which they face. To focus world attention upon this problem is an accomplishment per se.

As to the likelihood of an IDA or a SUNFED within the immediate future, it is the thesis of the dissertation that the establishment of an International Development Authority premised on a consensus concerning the mutual economic and political welfare of all nations faces a formidable handicap because there has not been a wide enough acceptance of the requisite perspective of a viable world community.

375 pages. \$4.80. Mic 57-2214

POLITICAL SCIENCE, PUBLIC ADMINISTRATION

THE MUSKINGUM WATERSHED CONSERVANCY DISTRICT: AN APPRAISAL OF A WATERSHED MANAGEMENT AGENCY

(Publication No. 21,167)

Lyle Eggleston Craine, Ph.D.
University of Michigan, 1956

The purpose of this dissertation is to present a case study appraisal of the development and operation of a watershed management agency. The Muskingum Watershed Conservancy District, created in 1933, joined together sixteen counties in southeastern Ohio to promote a comprehensive watershed program. This agency, like TVA, established the same year, is a demonstration of watershed management through a partnership of federal, state, and local units of government. TVA operates under federal leadership; the Muskingum District, under local leadership. In this day when workable patterns of "partnership" are sought, a study of the Muskingum undertaking is particularly significant.

The first part of this study develops tentative "principles" for the administration of watershed management and suggests "criteria" of a watershed management agency. These are based upon the significant experiences in watershed and river basin management throughout the nation during the first half of the twentieth century. The character of the problems in the Muskingum Basin, the efforts to motivate and organize the people of the region, and the creation and metamorphosis of the Muskingum District and its programs are viewed against these proposed "principles" and "criteria."

The Muskingum experience suggests that an important role of a watershed management organization is that of stimulator and coordinator of state and federal agencies working within its area on various aspects of land and water. The effectiveness of the watershed agency in this respect depends upon (1) its ability to exercise leadership in the "watershed community" on land and water problems, (2) the possession and exercise of authority for financing

and operating certain phases of the watershed program, and (3) the extent to which it is active in the analysis of watershed problems and in planning needed measures to meet them.

The study concludes that the Muskingum Watershed Conservancy District was remarkable for its time in initiating a comprehensive program which conceived upstream land and water measures and strategic reservoirs on the main stream and tributaries as integral parts of a single program of watershed management. The depression created many obstacles to maintaining the local initiative and the broad scope which characterized the early Muskingum effort.

Important among these obstacles were: (1) a proliferation of uncoordinated federal emergency employment programs relating to land and water management in the Muskingum Basin, and (2) a growing reluctance on the part of the people of the Muskingum Valley to assume local assessments for its program. Flood control became the dominant purpose, and the federal government progressively assumed an increasing proportion of the total costs. Gradually the district concentrated on forest and recreation management on the reservoir properties associated with the fourteen dams provided by the federal government. Its attention to over-all watershed problems diminished; its position of leadership in the watershed community deteriorated; and its effectiveness as a coordinator of land and water management was impaired.

This study points out the need for the Muskingum Watershed Conservancy District to exercise its legal powers in re-establishing its position of leadership. To achieve this position the study recommends that the district organize citizens' committees to conduct surveys of various aspects of the land and water problems and potentialities of the basin in the light of today's prospective needs and technology. Such surveys would build community support for the district to go forward with new phases of a balanced watershed management program and to finance such programs, to the extent necessary, by the levy of benefits assessments authorized by law. With active citizens' support backed up by a demonstrated ability to finance the appropriate local share of an expanded program in land and water management, the Muskingum Watershed Conservancy District can become an effective agent of watershed coordination in the Muskingum Valley.

345 pages. \$4.45. Mic 57-2215

COOPERATIVE PURCHASING TECHNIQUES FOR MUNICIPALITIES

(Publication No 21,183)

Clyde Thomas Hardwick, Ph.D.
University of Michigan, 1956

This study is concerned with the investigation and analysis of one particular type of municipal buying, generally termed "cooperative purchasing." Although local buying in small quantities is relatively costly, it could achieve potentially great economy in cooperative purchasing which as yet has not been widely adopted. Three problems present themselves: the ascertainment of reasons for lack of adoption; the formulation of a workable standard

plan of joint buying; and the organization of suggestions to encourage the wider use of cooperative purchasing.

In Chapter I, joint buying is integrated with the general principles and practices of modern procurement. More specifically, joint buying is examined in terms of the basic purchasing skills, namely: economic, technical, negotiating, and contracting techniques, as well as managerial considerations.

The major attempts at cooperative buying are described in Chapter II. Three general types of joint buying are analyzed. Attention is given first to joint buying plans under the leadership of municipalities, such as practiced in Cincinnati and Milwaukee. The second kind of group buying to be explained is the type of plan under the direction of a state purchasing department, as in Alabama. The analysis of the forms of joint buying is ended with a discussion of those plans under the coordination of a nongovernmental office, as illustrated by the Michigan Municipal League plan.

The opinions offered in reply to a circulated questionnaire were reviewed and analyzed in Chapter III. The questionnaire was organized to determine the opinions of interested governmental personnel and others concerning the scope, appropriate uses, and problems of joint buying. About one-third of the seventy-four respondents reported active participation in cooperative purchasing. The replies indicated a preference for joint purchasing under these circumstances: a competitive market condition; international peace rather than war; and repetitive purchases, illustrated by office supplies. The respondents also favored the use of formal contracting, "blanket" contracts, and firm unit pricing for joint buying. The replies of almost two-thirds of the respondents expressed the belief that joint buying will increase in volume during the next five years.

Those experienced with joint buying reported concrete results achieved as including: lower prices for joint purchases, standardized quality, and stimulation of cooperative action among independent units. These reports bear out general advantages claimed for joint buying by its proponents.

The study also discovered some major obstacles to joint buying. Among these the following were prominent: legal difficulties, especially inconsistent ordinances; political obstacles, such as provincialism; economic influences, particularly the desire to buy locally; and administrative troubles, including the lack of a separate coordinating office under a full-time director.

A model plan of joint buying was constructed and presented in Chapter IV. This proposed model plan offered a suggested organization, comprehensive procedures, and standardized forms adapted especially to cooperative purchasing.

Up to the time of this study, cooperative buying has been attempted as scattered experiments only. In general, widespread cooperative buying awaits several constructive steps by municipal leaders. More favorable attitudes must be stimulated among local administrators toward group action. In a practical sense, a specialized organization, standardized procedures, and uniform forms are needed. Without recommending any specific organization, it appears that some national leadership must be found in order to give central direction and encouragement to those interested in joint buying activities.

195 pages. \$2.55. Mic 57-2216

ORGANIZATION AND ADMINISTRATION OF LAW ENFORCEMENT IN THE UNITED STATES

(Publication No. 18,706)

Evan A. Iverson, Ph.D.
University of Utah, 1956

Chairman: Dr. Ellsworth E. Weaver

The greatest problem confronting the United States in police administration is the extreme decentralization of the enforcement machinery. There are approximately 40,000 different police organizations operating in the United States at the present time, and if every government, no matter how small, is to maintain a separate police force, the complexity and dispersion will undoubtedly grow rather than decrease.

The basic organizational structure of American law enforcement has remained unchanged even though the United States has been transformed into an industrial nation tied together by a detailed network of communications and rapid transportation systems. Law enforcement in the United States is considered to be primarily a local function, but the federal government has gradually become more involved, because modern living has for all practical purposes erased traditional divisional lines.

Federal Enforcement Agencies

The nonmilitary police functions of the federal government are largely performed by sixteen bureaus in the Justice, Treasury, Post Office, and Interior Departments. The Justice Department has traditionally been considered the center of federal law enforcement activities, but the Treasury Department actually has more personnel and expends more funds for this function. When it was established in 1908, the Federal Bureau of Investigation became the first general investigative agency in the United States, and some persons desired it to grow into a national police department. Even though some type of a consolidated federal enforcement agency has been repeatedly urged by public commissions and private groups, no major integration of functions has taken place. The jurisdiction of each agency is vaguely defined and any coordination which has been accomplished has been done largely by the officials themselves rather than by a system that requires it.

State Police Forces

The most significant development in the American police structure in this century has been the establishment of successful state forces. These agencies developed slowly after use of the militia and state control of local enforcement agencies had been unsuccessfully tried during the nineteenth century. At the present time every state has some enforcement agency, and in all but eleven states these organizations now possess general police power. Only slightly more than half of those possessing such powers indicated that they performed regular criminal investigation and apprehension services. Any true differentiation between highway patrols and state police departments must be made according to purpose rather than either title or actual powers.

The general trend has been for the states to assume an even greater responsibility in rural crime control but to remain out of the larger cities. The major contribution which the state police forces have made to local enforcement

agencies has been in providing statewide aid through communications, criminal identification bureaus, training facilities, and assistance in emergencies. Many states have training academies; seventeen states hold specialist schools; and twenty-five offer command training courses.

Although a great deal of opposition remains to state police forces having powers as extensive as those exercised by certain eastern states, such as Massachusetts and New Jersey, gradual consolidation of services and extension of powers would seem to indicate that the state will gradually assume the major responsibilities for both traffic and crime control for smaller municipalities and rural areas. The activities of large city forces will probably not be greatly affected by state agencies.

Rural Law Enforcement

In spite of the impressive quantity and quality of evidence which has piled up against the sheriff as peace officer, no reform movements have been able to abolish the office in any state. The long descending curve, marking the decline of the sheriff's office promises to remain unbroken, so any actual improvement in the near future in rural enforcement is not likely to occur by abolishing the office, but rather through a reallocation of functions and greater state assistance and control.

The sheriff is an appointed official only in the state of Rhode Island. However, in twelve states sheriffs are no longer engaged in traffic control; in six, responsibility for crime control has been withdrawn; and in three the custody of the jail is no longer a function of the sheriff. In some urban counties the sheriff has become a court officer only.

Greater state control has taken place resulting in statutory authority in twenty-four states for the governor or the courts to remove a sheriff if he fails to enforce state laws.

Municipal Police Departments

The actual police operations of the United States are carried on mainly by municipal police departments and even though these forces receive a great deal of criticism, they are usually far more effective than other local police forces. The major management problem hindering efficient enforcement of city police functions is the direct administrative responsibility exercised by elected officials. The police boards which have remained from another era have largely been removed, but they are still present in numerous cities and are usually very inefficient administrative tools. A professional police chief has become a standard for most cities of size, but the average tenure is only four years for all cities over 10,000 population and 2.8 years in cities having more than 500,000 population. Such limited tenure is due to frequent changes in the city governing bodies, and indicates the extent to which elected officers become involved in general administration.

General Conclusions

In police organization and administration, it is first necessary to establish goals and then indicate where improvements can actually be effected. It has been satisfactorily proved, both in foreign countries and in the United States, that a law enforcement system can achieve centralization without becoming an oppressive tool to ruin freedom. In the federal government the objective should be to concentrate criminal law enforcement in the Bureau of Investigation, leaving internal and auxiliary enforcement

functions to the appropriate departments. Within each state a strong police force should be established providing criminal investigation and apprehension services and traffic control for all areas excepting cities which are of sufficient size to demand a higher more concentrated level of service. If the elected sheriff cannot be removed as the chief of the county, his function should be restricted to serving civil process, acting as a court officer, and maintaining custody of prisoners.

One of the greatest problems confronting local governments involves the extension of satisfactory and uniform police service to large metropolitan areas which sometimes include several counties and numerous cities. This problem can satisfactorily be solved only through the establishment of some form of metropolitan government having jurisdiction for all area-wide services. The police are too closely related to the governing boards and local tradition to permit any satisfactory solution through the usual coordination techniques.

It may be trite to add that police departments in the United States have much to learn from those systems tried in older societies and foreign nations, but the United States has largely overlooked this fact, and any change in the organizational structure or reallocation of functions might well take advantage of foreign experience, especially that of England. 255 pages. \$3.30. Mic 57-2217

VERA CRUZ, BRAZIL'S NEW FEDERAL CAPITAL (VOLUMES I AND II)

(Publication No. 20,046)

Hollister Kent, Ph.D.
Cornell University, 1956

This thesis was written because it was felt that if the story concerning the choosing of Brazil's New Federal Capital and District sites was not set down that perhaps it never would be recorded, or if it was, that it might be written by some person who did not have as good an opportunity to observe the development of the project.

During eighteen months as General Manager of the Brazil Office of Donald J. Belcher and Associates, Inc., Specialists in Aerial Photographic Surveys, and later as Consultant to the Sub-Committee on Urbanism of Brazil's Commission for the Location of the New Federal Capital, it was possible for the author to collect the historical information, to observe at first hand the technical work of the choosing of the sites for the Capital and Federal District as well as the work of the members of the Commission who made the final decisions and to find out the Ithaca part of the story, where the photo-interpretation studies and most of the planning decisions were made.

The thesis is divided into four parts. The first starts with the first recorded statement about moving the Capital from Rio de Janeiro to the interior in 1789 and views the work of subsequent commissions until 1954.

The second concerns the technical work of 1954 and 1955 done for the Commission for the Location of the New Federal Capital by Donald J. Belcher and Associates, Inc. It was not possible to be completely objective in this section as the author was so intimately involved, but observations have been made from the planner's point of view in addition to recording the historic decisions leading up to

the choice of the Capital site. The uses and limitations of the new science of aerial photo-interpretation are shown, particularly as they apply to undeveloped sections of the world, to guide others who might find themselves in similar situations.

The third part starts with the story of the delimitation of the New Federal District around the chosen Capital site and contains recommendations for the form and function of this Federal District as a Metropolitan District.

The fourth part, based upon the assumption that the New Federal District would not be just a large city, but the most important one of a group of federated municipalities, contains regional recommendations for the development of such a Metropolitan Federal District.

These recommendations are generalized and are specifically not made in great detail, but are intended to stimulate imaginative Regional Planning within this Metropolitan District. Some warning flags have been raised and some positive suggestions made for the planners and administrators of this Metropolitan District. They have what is almost a unique opportunity to change the physical and governmental form of metropolitan districts and their components.

The thesis is presented in two volumes; the first contains the written material and smaller illustrations, and the second the larger maps and illustrations which should be used with the descriptive material in the first volume.

595 pages. \$7.55. Mic 57-2218

PSYCHOLOGY

PSYCHOLOGY, GENERAL

PERSONALITY PROJECTION THROUGH PICTURE INTERPRETATION AS A FUNCTION OF PHYSICAL AND SITUATIONAL AMBIGUITY

(Publication No. 20,072)

Joseph Leo Bingham, Ph.D.
Michigan State University, 1956

This study was designed to evaluate the contribution of physical ambiguity, situational ambiguity, theme type, and marital status to the productivity of picture type projection tests. Three levels of physical ambiguity, four levels of situational ambiguity (levels of overtness), and two theme types (sex and hostility) were employed. A complex analysis of variance design permitted examination of the variable interactions.

Productivity was measured in terms of number of words elicited, transcendancy scores, and amount of projection as determined by the clinical judgment method. Analysis of the words and projection data revealed that neither measure produced significant differences with respect to any of the variables. The transcendancy data did, however, produce numerous differences as are indicated in the conclusions which follow.

Physical ambiguity. The classical position states that the role played by internal and social factors decreases with the stability, clarity, or structuredness of the stimulus. Earlier studies appeared to refute this position as it was found that an increase in the physical structure of the stimulus resulted in an increase in the amount of fantasy elicited. The results of the present study fail to support either position, as no differences were found with respect to physical ambiguity.

Situational ambiguity. The sexual stimulus depicting the least amount of "overtness" was found to produce significantly higher transcendancy scores than more "overt" sexual stimuli. No differences, with respect to this variable, were found within the hostility continuum.

Theme type. Type of theme contributed jointly with other variables to produce numerous significant interactions.

The most meaningful of these interactions involved marital status, and will be discussed under that heading.

Marital status. The data revealed that married subjects received higher transcendancy scores to hostility stimuli than sex stimuli. It was also determined that married subjects reacted in accordance with the theme type depicted; that is, with sexual stories to sexual stimuli, etc. Unmarried subjects, on the contrary, received significantly higher transcendancy scores to sex stimuli than hostility stimuli, and gave a significant number of hostility stories to sexual stimuli.

It is not felt that the findings presented above support the contention that projection stimuli need only be physically ambiguous to be productive. On the contrary, it appears that this variable has little if any relationship with productivity. Situational ambiguity seems to be a more critical variable and one worthy of further systematic investigation.

99 pages. \$2.00. Mic 57-2219

GAMBLING PRONENESS: ITS MEASUREMENT AND EXPRESSION IN EXAMINATION SITUATIONS

(Publication No. 21,169)

Lee Erle Danielson, Ph.D.
University of Michigan, 1956

The main objectives of this study were: (1) to determine if, in exam situations of this type, a measurable personality variable, "gambling proneness," exists, and (2) to determine the influence of the ambiguity of the situation and of the importance of the examination to the subject upon the expression of the personality variable.

The study was conducted at the University of Michigan during the fall semester 1953-54. The sample consisted of the students in an intermediate psychology class, Psychology of Management. Four multiple choice exams, each with thirty to thirty-three questions, were given during the semester. An unconventional method of administering and scoring the exams was employed. This method permitted

the students to utilize partial knowledge, as well as complete knowledge, and imposed a "heavy" penalty for gambling.

The examination results afforded the basis for the development of "gambling indices" which were used as the measure of gambling proneness. The repetition of the indices (classified into low, middle, and high gamble categories) from exam to exam and over the semester was the primary indicator of the existence of a personality variable. The relationships of these gambling indices to levels of expectation served as secondary evidence.

The unfamiliarity of the students with this type of exam afforded an opportunity to investigate the influence of ambiguity on the expression of the personality variable. The longitudinal aspect of the study, four exams over a sixteen week semester, permitted investigation of the influence of importance.

The repetition of gambling indices from exam to exam and over a series of exams (three and four exams) was significantly greater than could be expected by chance. The degree of gambling proneness was positively related to the levels of expectations set, e.g., high gamble and overestimation. The repetition of the indices was not significantly influenced by scoring in the middle and high two-thirds of the class distribution, "reward," or in the low one-third, "punishment."

The students responded to the influence of ambiguity by exhibiting cautious behavior, proportionally more low gambling indices, and underestimations on the first exam than on subsequent exams. Once this ambiguity was reduced (i.e., the second exam), the tendency was reversed radically and then the trend toward caution appeared (i.e., the third and fourth exams), as the importance of the exams increased.

The principle of "minimaxing the loss" was hypothesized and supported as the characteristic method of response to exams of this type.

The major conclusions were: (1) a personality variable, gambling proneness, does exist and it can be measured by the use of gambling indices, and (2) ambiguity and importance influence the expression of the personality variable, whereas reward and punishment do not.

107 pages. \$2.00. Mic 57-2220

ANALYSIS OF ADJUSTMENT IN THE TUBERCULOSIS PATIENT

(Publication No. 21,217)

Patrick Joseph Driscoll, Ph.D.
The University of Wisconsin, 1957

Supervisor: Professor Karl U. Smith

This research was designed as a special analysis of the adjustment in the tubercular patient in the sanatorium. It had as its main objectives, (1) the description of adjustment of the tubercular patient in the sanatorium, (2) the development of a special rating form for the evaluation of such adjustment, (3) the development from available standardized tests and from the personality test, designed especially for this study, of a general test to predict adjustment of patients in the tubercular sanatorium and (4) the

determination of special relationships between personal factors and evaluated adjustment in the sanatorium.

This study was divided into several stages as follows:

(1) A pilot study in which preliminary investigations were carried out, the criterion rating forms developed and the preliminary test battery administered and then analyzed, (2) A main study in which criterion ratings of adjustment were obtained, the preliminary Institutional Adjustment Inventory administered, an item analysis carried out on the tests and certain personal history items related to criterion rating, (3) A cross validation study in which the revised Institutional Adjustment Inventory (resulting from the item analysis of stage 2) was administered to patients in three other sanatoriums and data thus obtained related to ratings of adjustment.

Evidence from the research suggests a positive relationship between the correlates of good adjustment in the sanatorium and those found associated with good adjustment in normal life situations. This observation is borne out by an intensive analysis of objective tests and certain personal history data and the relationships shown between such information and criterion ratings of adjustment. The conclusion states above is contrary to the findings of a previous study conducted in a state prison.

Other relationships between personal history information and evaluations of adjustment affirm the validity of the criterion rating. Comparison of adjustment ratings with discharge status, marital status, incidence of previous admission and diagnosis on admission shows significant relationships for both male and female patient groups.

Cross validation of a general test to predict adjustment, derived in a main study of one sanatorium, failed to show positive results. In view of the fact that the predictive devices used had high reliability, failure of cross validation is interpreted as due to differences in the adjustment climate of the three different sanatoriums in which the cross validation was conducted. These differences relate to dimensions such as size of group, institutional leadership and organization, degree of group or institutional isolation, etc.

A new test designed especially for this study and based on a new type of item was shown to be reliable and discriminated in a significant way between different rated levels of adjustment among patients in a large metropolitan sanatorium. A higher proportion of items of this inventory survived successive analysis than any of the four other personality tests used.

Three main variables must be considered in interpreting and predicting the adjustment of the tubercular patient. These include the patient as an individual, the seriousness and development of his disease and the sanatoriums as a social complex. 200 pages. \$2.60. Mic 57-2221

COLLEGE STUDENTS' CONCEPT OF EFFECTIVE TEACHING DETERMINED BY AN ANALYSIS OF TEACHER RATINGS

(Publication No. 21,203)

Grace Marian French, Ph.D.
University of Washington, 1957

The purpose of this investigation was to discover what teacher characteristics, measured by a set of verbal

statements, are related to students' high or low opinions of their college teachers.

The design of the problem involved the determination of the relative contribution of each of a set of component judgments to an over-all complex judgment of teaching effectiveness. Students in the classes of a sample of college faculty registered judgments of their teachers on a set of forty-one verbal descriptions phrased as items on a scale. The students also registered judgments of their instructors' over-all teaching effectiveness. The forty-one items were treated as a set of predictors of the over-all judgment, the criterion. The methodology used was developed by Horst and involves the calculation of the multiple regression weight for each predictor from the factor loading matrix obtained by a principal axis solution of the predictor intercorrelations.

The findings of the study provide information about the dimensionality of student judgment and permit the rank-ordering of the forty-one items on the basis of the contribution of each to the variance of the over-all judgment of teaching effectiveness. The high multiple correlation obtained indicated that the set of items accounted for all but a small percentage (less than 11%) of the systematic variance of the criterion. The factor analysis revealed that there are probably not more than eight dimensions to the students' concept of effective teaching, and also made clear the fact that one of these factors is of much greater importance than all the others. A second factor and possibly a third appear to be of some importance, and the others contribute only in a very minor way.

The ten items which contribute most to student over-all judgment are the following: (1) Interprets abstract ideas and theories clearly; (2) Gets students interested in the subject; (3) Has increased my skills in thinking; (4) Has helped broaden my interests; (5) Stresses important material; (6) Makes good use of examples and illustrations; (7) Motivated me to do my best work; (8) Inspires class confidence in his knowledge of the subject; (9) Has given me new viewpoints or appreciations; and (10) Is clear and understandable in his explanations. Five of these items (numbers 2, 5, 6, 8, 10) were among the top ten in the studies of E. R. Guthrie, carried out more than a generation ago, in which students were simply asked what characteristics were important to good teaching. Other items at the top were suggested by faculty members. These two facts suggest that student notions of good teaching are rather stable and may not be different in their significant aspects from faculty notions of this function.

It is suggested from the content of the top group of items that effective teaching, from the student's point of view, seems to involve the arousal or broadening of interest, which has a motivating or stimulating effect, and which is achieved through a clarity of exposition requiring knowledge, ability to illustrate, and to stress or emphasize importance. Another conclusion is that neatness of appearance, friendliness of manner, sense of humor, the giving of individual attention, and the handling of examinations carry little weight in the students' descriptions of effective teachers. 69 pages. \$2.00. Mic 57-2222

A STUDY OF RESPONSES TO A WORK ACTIVITIES CHECK LIST TO DETERMINE FUNCTIONAL JOB INTER-RELATIONSHIPS

(Publication No. 21,288)

Duane Morton Johnson, Ph.D.
Purdue University, 1957

Major Professor: E. J. McCormick

A problem in industrial psychology in which job inter-relationships were investigated by studying responses to a check list of work activities applied to specific jobs in the motor vehical maintenance and repair occupational field.

A check list of activities and things worked on in the motor vehicle maintenance and repair field was developed from items extracted from various published sources and with the assistance of experts in the field. Items were grouped logically according to the apparent relationships among things worked on and functionally according to operations performed.

Forms were mailed out to 142 individuals and companies in Indiana and nearby states to obtain completed check lists on as large and diverse a sample of jobs as possible. Twenty eight contacts returned a total of 144 usable check lists.

Sections of the check list were scored by totalling the number of checks made in each of 38 divisions of the check list. Distributions of response-frequency scores were dichotomized and phi coefficients computed for each pair of variables. Simple centroid factor extraction produced eight orthogonal factors, which, after rotation by wholly graphic means, were identified as I, General Mechanic Activities, a general factor; II Inspect-Diagnose-Analyze Activities; III, Electrical Activities; IV, Cooling System Activities; V, Body Work and Upholstery Activities; VI, Servicing Activities; VII, Brake Correction Activities; and VIII, Power Plant Mechanical Activities.

Forms were re-scored by totalling checks made on variables entering into each factor. Distributions were dichotomized and each job given a "high" or "low" factor score for each factor. Patterns of high-low factor scores were compared. Thirty four patterns described all 144 jobs, 104 jobs being described by only four patterns.

The following conclusions were drawn:

1. A complex work area can be reduced to work activity elements that can be presented in check list form.
2. The check list technique, applied to specific jobs by workers on those jobs, can reveal factors operating in a number of different jobs.
3. Jobs, scored for the presence of various factors, can be described by a limited number of patterns of factor scores.
4. Factor-score patterns can provide a rough but easily applied means by which jobs can be compared, job applicants' experience can be evaluated, and training needs can be identified.
5. Further research is needed to refine, shorten, and simplify the check list, but within a logical framework of meaningfulness to the worker, and to identify factors operating in those jobs to which the present check list appears to be insensitive. 76 pages. \$2.00. Mic 57-2223

FORMAL AND CONCRETE THOUGHT PROCESSES

(Publication No. 20,123)

John Augustus Keats, Ph.D.
Princeton University, 1955

This project was an empirical investigation of predictions derived from a theory by Piaget concerning the development of intelligence. In particular, three content areas were to be studied, making use of group testing procedures and special statistical techniques for analysis.

Piaget defines a mental operation as an internalized act, i.e., the external object is represented symbolically in the mind of the subject who instigates behavior with respect to the symbol. Concrete operations are operations on the symbols of objects that can be manipulated through the senses. Formal operations are operations on concrete operations. His theory implies a steplike development of intelligence and the possibility of demonstrating that there are children who can carry out concrete operations but not formal and that all children who can carry out formal operations can also carry out concrete operations. An empirical finding reported by Piaget is that children in general change from the concrete to the formal operations between their twelfth and fifteenth birthdays. Of course, some children make the change before this period and some afterwards, and others again probably never do. Conditions which facilitate or inhibit this change are not explicitly stated by the theory.

In the area of arithmetic, for example, Piaget's theory of intelligence is interpreted as representing the development of intelligence as a process of building up a set of elements and an operation with respect to this set, such that the conditions for a semigroup are satisfied. In this way the stage of concrete operations is established. Later in the developments of the individual the condition of an inverse is added and this with the unit changes the semigroup into a group. This is the stage of formal operations.

The theory was examined with respect to three content areas, arithmetic, probability and inequalities (also referred to as "comparisons"). In the area of arithmetic, pairs of problems were prepared, one of which required reversibility of operations in the sense that an operation combined with its inverse leaves the original number unchanged, whereas the other could be solved by normal computational operations. In the area of probability theory formal operations were examined through the notion of independence. The children in effect were given in one problem that a certain number of object A and a certain number of object B were placed in a box and were asked which object, A or B, was most likely to come out by random drawing. In another problem it is given that one more of either object is in the box but that it has been removed by chance drawing before they have to decide which is most likely to come out. Formal operations in this case lead to the notion of independence which is an important condition for operations on probabilities. In the case of the comparisons items the items differed solely on the basis of generality. Such items do not examine the theory as stated, but were included for other reasons related to Piaget's work and to evidence found in the literature. The effect of generality was examined also in the other content areas.

Data were obtained by administering 74 items, some of which had several parts, to children from Grades IV, VI,

VII, VIII, AND X. Approximately two hundred from each of the first two grades and three hundred from each of the upper three grades were tested. These data were punched onto IBM cards and analyzed in terms of the relationship between matched pairs of items. The results of this analysis indicated that six of the seven arithmetic item pairs were related in a way suggested by the theory. The seventh item pair required operations with fractions; further study of such items is suggested. For the probability items effects which could be attributed to lack of appreciation of the notion of independence were obtained with Grade IV and Grade VI children. Children in Grades VII, VIII, and X behaved somewhat differently, but this could have been due in part to the effect of the influence of a variable not anticipated in the planning of these items. Further study of this type of item is suggested. No effects were obtained with the inequalities items. Specific suggestions are made as to how items in this area could be constructed that require reversibility of operations.

In general, it was concluded that the group testing situation could be used experimentally with systematic variation of the content of items. Piaget's theory was used as the basis of this variation and certain predicted results were obtained. Some specific suggestions for further studies arose from the results of this study.

196 pages. \$2.55. Mic 57-2224

AN INVESTIGATION OF PIAGET'S CONCEPT OF THE DEVELOPMENT OF MORAL JUDGMENT IN SIX- TO TWELVE-YEAR-OLD CHILDREN FROM THE LOWER SOCIO-ECONOMIC GROUP

(Publication No. 21,250)

Gene Roland Medinnus, Ph.D.
University of Minnesota, 1957

Adviser: Elizabeth M. Fuller

The primary purpose of this study was to investigate the responses of a carefully selected sample of lower socio-economic class American children in a standardized interview situation to a series of stories closely similar to those employed by Piaget in his studies of the moral judgments of Swiss children (1). The extent and quality of sex differences in this particular area of child thought were also investigated. A quantitative treatment of the responses of the subjects at the four age levels used in the study yielded information pertinent to Piaget's hypothesis concerning the change with age in children's moral judgments. A qualitative examination of the responses furnished indications bearing on the validity of the stories in measuring the attitudes and orientations intended by Piaget and indications relating to the applicability of the stories, their content and purpose, in use with American children.

Two hundred and forty children, 30 boys and 30 girls at each of the following age levels, 6, 8, 10, and 12, served as subjects. The subjects were selected from the lower socio-economic groups, specifically from classes V, VI, and VII according to the Minnesota Scale for Paternal Occupations. To eliminate possible differences due to amount of school experience, the age-grade placement of

the subjects was controlled. Two further sample restrictions were also imposed: no special-class children were used, and white children only were selected.

Eighteen story-situations and questions drawn from Piaget were administered to each subject individually in a structured interview situation. The subjects' responses to the questions were recorded verbatim by the examiner.

The responses were scored plus or minus following Lerner's technique based on Piaget's discussion of moral realism. A plus score indicated that the item was answered in the direction of moral realism, while a minus score denoted a "mature," relativistic response. In comparing the differences in the responses between the four age groups for each item, the Chi-square statistic was computed from 2 x 4 tables.

The following results and conclusions emerged from the study:

1. The responses to all five of the stories dealing with objective responsibility showed a significant change with age from a notion of objective responsibility in which judgments are made in terms of consequences to a sense of subjective responsibility characterized by a concern with intentionality.

2. Few significant relationships were found between age and the subjects' responses to the stories dealing with various aspects of the child's sense of justice. This does not accord with Piaget's assertion that there is a marked shift with age from an attitude favoring obedience and expiation to one emphasizing equality and punishments by reciprocity.

3. Few statistically significant sex differences were found in the subjects' responses to the stories included in the study.

4. Several factors which must be recognized and dealt with in interpreting children's responses to the type of story situations used in this area of investigation were pointed out:

- (a) The young child perceives and evaluates situations in a concrete manner in terms of his own experiences while the older child possesses a higher level of conceptual ability which permits him to consider extenuating circumstances and to make generalizations.

- (b) It is necessary to determine the basis upon which children of different age levels interpret a story or situation. Often a story does not mean the same thing to children representing a fairly extended age range.

- (c) It is advisable to demonstrate empirically that a story elicits the type of information for which it was designed before conclusions are drawn concerning the results obtained. It is impossible to give an *a priori* answer to the question, "Does the meaning which the subjects derive from this story satisfy the purpose for which it was intended?"

A number of suggestions for further research were discussed. Possible procedures for testing several hypotheses formulated on the basis of the present findings were briefly outlined.

Reference

1. Piaget, Jean. *The moral judgment of the child*. trans. M. Gabain. Glencoe, Ill.: The Free Press, 1948. 196 pages. \$2.55. Mic 57-2225

THE STRUCTURE OF BELIEFS AMONG SELECTED COLLEGE FRESHMEN

(Publication No. 20,217)

Edwin G. Spacie, Ed.D.
Michigan State University, 1956

Factor analysis was used to study the organization of beliefs among college freshmen who attained "middle scores" on the Inventory of Beliefs.

From among 2953 freshmen who entered Michigan State University in the fall of 1954, all those having a score on the Inventory of Beliefs equal to the mean score of the total group, \pm one raw score unit, were selected as the "1954 population." These comprised 179 men and 80 women, treated separately because of the significant difference in the group means found when divided on sex. As a "second population" 150 men and 100 women were selected by the same criterion from among some 3200 freshmen who had voluntarily attended summer counseling clinics at Michigan State University in 1950, 1951 and 1952.

Treating the 120 items of the Inventory of Beliefs as separate tests, the inter-item correlations for the 1954 populations were obtained as tetrachoric *r*'s. The resulting correlation matrices were factor analyzed, using the Thurstone Centroid method. Factors were rotated in accord with the criteria for simple structure.

To demonstrate the non-chance character of the factors calculated, "pseudo-factors" were constructed, each having the same weight distribution as the corresponding factor, but with items and signs determined by a table of random numbers.

Keys were made for the factors and pseudo-factors and the populations were re-scored. The *t*-test was used to estimate the significance of the differences in variance of the resulting score distributions.

Lists of items having maximum loading on one factor and minimum loadings on the other were submitted to a panel of judges in an attempt to determine the psychological meanings of the factors.

The following results were obtained:

1. Two factors were calculated from each matrix. More factors probably could have been determined.
2. The factors accounted for significantly more variance within each population than did the pseudo-factors.
3. The variance for each factor differed significantly between the two populations, while the variance for each pseudo-factor did not.
4. The judges reached very little agreement on the psychological meanings of the factors.

The following conclusions were drawn:

1. Most, perhaps all, "middle scorers" have structured belief systems.
2. It is generally these structures and their polar nature which accounts for the middle score.
3. The factors were recognizable in groups separated by two to four years.
4. The factors demonstrated some stability in the face of certain social changes.

5. Groups known to differ, but indistinguishable by their total Inventory of Beliefs scores, were differentiated by the factors.

88 pages. \$2.00. Mic 57-2226

THE EFFECT OF NEED FOR ACADEMIC
ACHIEVEMENT ON THE PERFORMANCE OF
COLLEGE STUDENTS IN LEARNING
CERTAIN STUDY SKILLS

(Publication No. 21,464)

Verne Arthur Walter, Ph.D.
The Ohio State University, 1956

The study was designed to explore the possibility of measuring the need for academic achievement from the content of imaginative thought, and to assess the effect of this motive on performance in learning certain study skills. The question which guided the research was: Will students who differ in academic achievement motivation, as inferred from fantasy productions to a picture interpretations test, show significantly different performance in learning reading and note-taking skills?

The study was conducted over a period of ten weeks as part of the laboratory work of a how-to-study course taught in the Department of Psychology at the Ohio State University. The subjects employed were third-quarter freshmen enrolled in this course (N=74).

Subjects were classified into three groups representing high, medium, and low motivational levels on the basis of scores derived from the analysis of the content of stories written to a picture interpretations test. The test was composed of six pictures drawn to suggest the possibility of study activity to a greater or lesser extent. It was administered under two conditions of motive arousal designed to vary the degree to which good performance would be interpreted as evidence of competence in a college setting. First, the students were tested under a Task-oriented set of instructions, and second, under an Academic Achievement-oriented condition. To assess the differences between groups on performance in learning reading and note-taking skills, measures were obtained at the beginning and end of the training period on reading rate, comprehension accuracy, working rate while reading and taking notes, and quality of notes. A v^1 test of significance was used to determine the significance of differences on performance in learning these skills. Analyses were made on groups that were matched with respect to verbal ability and initial level of performance on the particular skill in question. The size of the groups ranged from seven to fourteen subjects, and data were analyzed separately for each sex. Additional analyses were made with respect to the effect of the determinants of \bar{n} Academic Achievement score; the score-rescore consistency and the inter-scorer agreement of those who judged the protocols of the picture interpretations test; and the reliability of the raters who scored the quality of notes.

It was found that in only one comparison on performance in learning reading and note-taking skills between groups of subjects who differed with respect to level of need for academic achievement did the observed differences reach the 5 per cent level of significance. This

finding was in relation to improvement in reading rate and comprehension accuracy between groups of male subjects of low and medium levels of motivation as inferred from total \bar{n} Academic Achievement scores obtained under the Academic Achievement-oriented instructional condition. Among the minor findings it was noted that the \bar{n} Academic Achievement score was significantly greater in response to high than to low academic cue pictures. No significant differences in \bar{n} Academic Achievement scores were evident between Task- and Academic Achievement-oriented instructional conditions. A high degree of consistency was found between and among judges in scoring the picture interpretations test and in rating notes for quality.

The guiding question of the study is, in general, answered negatively. Since picture cue-value was found to be the chief determinant of \bar{n} Academic Achievement score, it was concluded that the picture interpretations test was probably not a measure of the strength of need for academic achievement. It is thought that the test is a measure of certain culturally determined and somewhat stereotyped response tendencies. 176 pages. \$2.30. Mic 57-2227

A PSYCHOLOGICAL INQUIRY INTO
SATISFACTIONS AND HAPPINESS

(Publication No. 20,168)

Alden Ebenhart Wessman, Ph.D.
Princeton University, 1956

Adequate formulation of the nature and sources of satisfactions and happiness is a recurrent human concern. A survey of the various accounts in the history of Western thought shows their reflection of contemporary knowledge and philosophical orientations and corresponding changes. Most formulations have seen happiness as contingent upon desire and its attainment; however, conceptions of its exact nature and probable realization, and also of the fundamental objects of desire, have been notably divergent. An adequate psychological account must recognize and include the persistent, inescapable influence of moral and ethical considerations. Far less "rationalistic", "abstract", or "ideal", more recent approaches have focused upon the dynamisms of organized personalities in their situational relatedness. Characteristic of our time are "adjustment" conceptions of happiness, possessing considerable merit, but not above criticism.

Contemporary systematic psychological research on happiness has had as major foci the relations of: mood and temporal aspects of the affective life; characteristic traits, interests, and attitudes; and satisfactions in particular life areas. Of the possible manifestations including: (a) bodily signs, (b) spontaneous or elicited statements and self-ratings, and (c) behavioral evidence of a more indirect sort (projections, etc.), the second has been most employed. Evidence suggests self-ratings of happiness are fairly reliable. Validity is problematic due to uncertainty regarding the proper criteria. Research studies have not adequately investigated the role of basic personality processes and have been insufficiently representative in the populations investigated. The present study supplements the latter deficiency.

Review of a series of post-World War II large-scale

public opinion surveys in various Western nations reveals consistently high levels of avowed happiness and low levels of avowed unhappiness (usually less than 10%), with the sole exception of France (40% unhappy). Definitions of "happiness" obtained in the various nations are compared.

Detailed analysis of a large-scale (N = 2,377 respondents), representative, national U.S. public opinion survey is concerned with statistical assessment and interpretations of relationships between avowed happiness-unhappiness and various social-psychological background characteristics; experiences in important life areas; and general attitudes. No single background, experiential or attitudinal factors unerringly differentiate avowedly happy from unhappy; however, many highly significant relationships are found. Most critical, by far, is experience within the marital and family relationships. Experiences and feelings with respect to work are also of major importance. Health, economic status, education, religion, and race are among the factors showing significant relation. Though admitted possession of some unfulfilled aspirations characterizes the majority, these appear more prevalent and accute among the avowedly unhappy. Worries are more conspicuous among this group and significantly higher regarding family and financial security. The "happy" appear better able to meet the demands of maturity. All tend to give similar definitions of happiness and its sources; however, the "happy" stress satisfying family life to a greater degree. Implicit moral judgments may be inferred from respondents' explanations of unhappiness: happiness appears regarded as reward for moral fitness and unhappiness as the consequence of moral shortcomings or personal deficiencies. Contemporary Americans appear to feel they should be happy and granted favorable circumstance they will be. Most striking is the consistently low level of reported unhappiness.

Additional questionnaire data from 150 subjects, collected with the purpose of assaying the relationships between "felt importance", "felt present attainment", "future expected attainment", and "felt satisfaction" in various life areas, reveals a striking preponderance of satisfaction self-ratings within a restricted and moderately high range on a ten-point scale. Moderately high levels of satisfactions are generally maintained despite fluctuation in ratings on the other "dimensions". Distribution of self-ratings on overall unhappiness-happiness resembles a "J-curve", suggesting conformity tendencies.

The diverse findings and considerations may best be interpreted and formulated about the concept of value -- a fundamental aspect of interested action sequences. Happiness and satisfactions appear intimately related to the maintenance and enhancement of functional value systems, those "psychological constancies" which guarantee stability of the personal world with significances and meanings appropriate for the acting individual. Happiness appears contingent upon realization of essential interests and continued appropriateness of the value constancies. Particular satisfactions may be regarded as experiential qualities accompanying the experiencing through action of the intended value consequences potential in a situation. Crucial aspects of satisfying experience involve evaluation of the activity, surety in the validity of its ends, confidence in the possible means of its realization, felt progress toward attainment, and, permeating all aspects, felt personal participation. These interdependent aspects are regarded as deriving from total organismic action sequences.

Satisfactions and dissatisfactions, happiness and unhappiness, represent significant indications of the integral human personality, playing critical roles in reflecting the consequents of the individual's interested action and in affecting its future course. 275 pages. \$3.55. Mic 57-2228

THE INTERPRETATION OF THE RORSCHACH TEST AS A FUNCTION OF INTERPRETER, DEGREE OF INFORMATION, AND THE SUBJECT'S PERSONALITY

(Publication No. 20,219)

Allen Eugene Willner, Ph.D.
Michigan State University, 1956

Major Professor: M. Ray Denny

The experiment is concerned with Rorschach interpretation as a function of interpreter, degree of information and subject. The interpreters were 5 staff psychologists at 2 V. A. installations, each of whom had at least 5 years of Rorschach experience. Five degrees of information were employed in the study:

- I. Psychogram. A Beck type scoring summary was used. In cases where the Rorschachs were scored according to another system, the experimenter rescored them according to Beck's system.
- II. Protocol, minus the inquiry.
- III. Core-concepts. These consisted of the major noun from each response in the protocol.
- IV. Psychogram plus core concepts.
- V. The whole record, minus the inquiry.

The stimuli were the Rorschachs of 15 subjects selected from the clinic files. The records were pulled at random from the files and the first 20 which met the following criteria were used:

- (a) Between 20 and 30 responses per record.
- (b) An average of at least six words per response.
- (c) The Rorschach was neither administered nor supervised by any of the interpreters in the experiment.

Five of these twenty Rorschachs were used in a pilot study, and the remaining fifteen were used in the experiment.

The measuring instrument was the Multi-dimensional Scale for Rating Psychiatric Patients (MSRPP), outpatient form. The MSRPP has been factor analyzed into 10 personality factors. The items in eight of these personality-factors were used in the experiment.

Every interpreter received each of the 15 Rorschachs. He was given the Rorschach of any single subject under only one of the five degrees of information. Every interpreter saw a total of three Rorschachs under each of the five degrees of information, and the order in which they saw them was systematically randomized. All interpreters were asked to fill out the MSRPP for each Rorschach they were given. The MSRPP was used as a quantifiable substitute for the usual Rorschach interpretation. The data were analyzed as follows:

- (a) A separate Latin-Square analysis of variance was employed for each of the eight personality-factors of the MSRPP.
- (b) Another Latin-Square analysis of variance was conducted for the scale as a whole. Thus a total of nine analyses were carried out.

A study of the results indicates that

- (a) There are differences in Rorschach interpretation which are attributable to the interpreter rather than to the records presented to him. The data also suggest that personality differences among the interpreters may well account for this effect.
- (b) Changing the amount of information did not seem to affect the Rorschach interpretation. Apparently even the minimal information conditions contained enough information for an interpretation--at least for the MSRPP equivalent of an interpretation.
- (c) The Rorschachs of different subjects were interpreted differently. However, the discrimination involved was coarse rather than fine.

48 pages. \$2.00. Mic 57-2229

PSYCHOLOGY, CLINICAL

THE RELATIONSHIP OF PARENTAL PERSONALITY STRUCTURES TO CHILD ADJUSTMENT AND ADOPTION SELECTION

(Publication No. 21,236)

Robert John Adrian, Ph.D.
University of Minnesota, 1957

This investigation dealt with the relationship between measured parental personality structure and child adjustment. A second purpose was to inquire into the feasibility of utilizing psychological tests as part of the basis for selecting foster parents from adoptive applicants.

The Minnesota Multiphasic Personality Inventory (MMPI) and the Minnesota Scale of Parents' Opinions (MPOS) were administered to parents of a sample of disturbed children and parents of a sample of well-adjusted children. The parents of the disturbed children consisted of 62 couples with children undergoing psychiatric or psychological examinations for emotional problems. Parents of the well-adjusted group consisted of 62 couples selected from membership lists of two Parent-Teacher Associations. The latter sample contained no parents whose children exhibited marked behavior problems.

The two samples of parents were not significantly different with respect to age, and paternal educational and occupational level. For the children of these two parental groups no significant difference was found in intellectual or educational level.

The generalized distance function, D^2 , and the linear discriminant function, LDF, were employed to yield the optimum combination of MMPI scale scores for differentiation of the clinic and PTA parents. Three LDF equations

were obtained: male, female, and similarity. Each LDF equation defined a new measure of parental personality structure as related to child adjustment. The MMPI profiles of the clinic parents were more aberrant than those of the PTA parents. Moderate or marked dissimilarity in the MMPI profiles for husband and wife appeared to be associated with inadequate child adjustment.

Five experienced clinical psychologists sorted the profiles of the clinic and PTA parents. The sortings of these judges significantly differentiated the parental groups.

The other instrument employed, the MPOS, is a test of parental attitudes. It did not differentiate between parents of the disturbed children and parents of the well-adjusted children.

The second part of the investigation dealt with the extent to which successful applicants for adoption were classified as normal through the use of the LDF equations, and the unsuccessful applicants for adoption were classified as abnormal by the use of the LDF equations. Similarly, there was an analysis of the degree of correspondence between the judges' sortings of MMPI profiles and the social workers' decisions. There were 55 accepted adoptive applicants and 46 rejected adoptive applicants. The findings demonstrated that the male LDF equation did not significantly differentiate the accepted and rejected male applicants. The female LDF equation was useful in classifying female applicants as possessing abnormal or normal personality structures. The application of the similarity LDF equation revealed a significant tendency for the rejected couples to be dissimilar in personality structure, and for the accepted couples to be similar.

Judges' sortings significantly differentiated the accepted and rejected applicants in terms of the decisions of the social workers. A substantial proportion of the rejected adoptive applicants were classified by the judges as possessing abnormal MMPI profiles.

The rules formulated were derived from the relationships among the LDF values of the couples. These rules were most effective when the female score and the similarity scores were congruent. Also, when two or three LDF values were above or below their respective LDF means, the classification of the couple was related to the decision of the social workers to accept or reject. Overlap between the groups made individual prediction hazardous.

A tentative application of the LDF equations in adoption selection was proposed. 231 pages. \$3.00. Mic 57-2230

AN EMPIRICAL STUDY OF THE EFFECTS OF ANXIETY AND FAILURE-SUCCESS UPON THE PERFORMANCE OF A COMPLEX TASK

(Publication No. 21,425)

Jean Lucille Burton, Ph.D.
The Ohio State University, 1956

The dissertation is an investigation of the effects of the interaction of a personality variable, anxiety, and a learning variable, failure-success, upon performance.

A modification of the Wisconsin Card Sorting Test, a concept formation test consisting of three sets of 75 cards, was chosen as the experimental task. The level of anxiety

was defined operationally as the score obtained on the Taylor Manifest Anxiety Scale (TMAS). The scale was administered to all students in the 411-412 Introductory Psychology course (in the summer of 1954) at the Ohio State University. The 20 per cent of the students obtaining the highest TMAS scores (anxious) and the 20 per cent obtaining the lowest scores (non-anxious) were then used as subjects. The 28 subjects in each group were placed in rank order based on the TMAS score. Two sub-groups of 13 subjects each were identified by the method of alternate ranks. One sub-group of the anxious subjects was assigned to the experiment to receive first success, then failure; the remaining sub-group received failure first, then success. The same assignment was made of the two sub-groups of the non-anxious.

The subject's task was to match the cards in a set with models presented to him; the examiner scored the task and, referring to fictitious norms, reported the results to the subject. If the subject was to receive a failure, he was told his performance was below average; if he was to receive success, he was told his performance was above average. The subject sorted the second set of cards, after which he was given a report of failure or success the opposite of that which he had received after the first trial. The third and final set of cards was then sorted.

The measure of the subject's performance was the percentage of correct sorts for a set of cards on a given trial. Comparisons were made of the subject's performance between trials 1 and 2 and 2 and 3 to ascertain whether he had increased or decreased in performance following success and/or failure. The Mann-Whitney U-test was the statistic used to evaluate the significance of the changes in performance.

No significant differences were found between the anxious and non-anxious who were tested under the pattern of success followed by failure. Some significant differences were found between the anxious and non-anxious who were tested under the pattern of failure followed by success. These differences were as follows:

- (a) A greater number of the non-anxious than of the anxious group increased in accuracy score following initial failure.
- (b) A greater number of the anxious than of the non-anxious group increased in accuracy score following subsequent success.
- (c) A greater number of the anxious group increased in accuracy score following subsequent success than following initial failure.

The specific conclusions which can reasonably be drawn from the results of this research are limited. First, success and failure do not have an equivalent effect upon performance. Success seems to engender further success, whereas failure's effect upon performance appears to be a function not only of the affective state of the subject but also of the immediately preceding reinforcement experience. Second, differences in affective state of the anxious and non-anxious result in a differential reaction to failure. However, this differential reaction can be avoided through previous experience or eliminated by subsequent experience. Third, the interaction of the two variables and the sequence effect of the reinforcement seem to combine so as to modify the "isolated" functioning of each enough to

alter the predicted form of reaction.

58 pages. \$2.00. Mic 57-2231

PHYSIOLOGICAL RESPONSIVENESS IN REACTIVE AND PROCESS SCHIZOPHRENIA

(Publication No. 21,054)

Spencer Harry DeVault, Ph.D.
Michigan State University, 1955

It has been suggested that the mental diseases commonly diagnosed as schizophrenia (of four classical types) may be distinguished on the lines of two basically different groups. These types, referred to as reactive and process schizophrenia, were differentiated in this study on the basis of case history and clinical data, according to the following criteria: (1) prepsychotic personality; (2) precipitating stress; (3) onset; and (4) clinical picture. The comparison of these two groups on the basis of physiological reactivity to various stimuli was the primary purpose of the study.

Two groups of chronic schizophrenics, eighteen in each group, and a group of eighteen normal control subjects were studied. Four pictures, one of neutral value and the others representing common conflict areas (hostility, dependency, sex) were used as stimuli. A loud bell preceded by a verbal warning was also used. The responses measured included base levels and amplitude of heart rate and GSR changes and arousal and recovery time of GSR.

The reactive group of schizophrenics showed a significantly higher base level heart rate than either the normals or the process group. There were no significant differences between the groups in base GSR.

The reactives responded like the normals in amplitude of GSR and heart rate change, except after the warning where their response was lower. They tended to make a slower recovery than the process or normal groups.

Amplitude of GSR for the process group was lower than for the other groups. The mean heart rate changes of this group were all negative and significantly different from the changes of the normals and reactives.

These results were interpreted to mean, primarily, that at least two groups, differing in physiological response to certain stimuli, can be distinguished within the classification of schizophrenia. These groups do not seem to be independent of the traditional subtypes, but can be differentiated independently of them. Both groups manifest withdrawal at a social level and in overt activity. They differ, however, in the extent of the withdrawal. The reactives were affected by other stimuli and responded strongly to them, their response reaching or exceeding the normal level. The withdrawal of the process group seemed to go much further, their responsiveness in this study being confined to what seems to be a reflex response to sensory stimuli.

The results thus indicate a more significant basis for classifying schizophrenia than the traditional four sub-types. The reactive-process distinction provides a differentiation meaningful in terms of etiology, treatment, and prognosis, and can discriminate these groups at both physiological and psychological levels. 83 pages. \$2.00. Mic 57-2232

SET AND CONCEPTUAL DEFENSE

(Publication No. 21,277)

Paul Dolinko, Ph.D.
Purdue University, 1957

Major Professor: J. M. Hadley

This study was designed to relate the theory and results of the perceptual defense experiments to the conceptual area. A design, analogous to some of the perceptual defense experiments and utilizing foreknowledge of the words to be presented, was applied to a conceptual problem. The conceptual test involved word association lists designed by the writer.

The two independent variables of this experiment were word loadedness and degree of preparation. Word loadedness was varied through the use of neutral and emotionally toned word lists. Degree of preparation was varied by administering one form of the word association test under standard conditions and a parallel form under prepared conditions in which the subjects had an opportunity to inspect the word lists prior to their administration.

Eighty undergraduate male students were randomly divided into four experimental groups. The design involved counterbalanced order on two variables: Emotional loadedness of the words and forms of the word lists.

It was predicted that there would be a longer reaction time to the emotionally toned words; a quicker response under prepared conditions; and a smaller difference between the reaction time to emotionally toned words and neutral words under prepared conditions than under unprepared conditions. All three predictions were confirmed.

The results were related to the function of set and hypothesis theory. The quicker response under preparation was attributed to information offering an added readiness to respond. The delayed response to the emotionally toned words was attributed to the function of antagonistic sets, that is, the set to respond as quickly as possible through conforming with the instructions being interfered with by motivational factors delaying the association time. The smaller differences under the prepared conditions were attributed to an interaction of these variables and implied that motivational factors played a primary role.

It was suggested that the results of the present experiment involving "conceptual defense" and those of the perceptual defense experiments may be due to the operation of the same factors at somewhat different levels. This could be the influence of hypotheses as discussed in hypothesis theory.

58 pages. \$2.00. Mic 57-2233

PERSONALITY CORRELATES OF RECOGNITION
AND RECALL OF FACES

(Publication No. 21,332)

Kenneth Walker Mann, Ph.D.
University of Michigan, 1956

This study was concerned with the recognizability and clarity of recall of facial images of self and selected others in relation to the perceiver's personality and his appraisal of the personalities of these others.

Relating to the assumption that organismic need for security results in the categorization of external objects to an extent impossible for the self-object, it was hypothesized that greater difficulty would be encountered in perception of one's own face than the faces of others, and that this difficulty would vary as a function of the variability of the self-concept. It was additionally predicted that this difficulty would vary with personality maladjustment.

An effort was made to ascertain whether the same variables were involved in perceiving faces of others as compared with other potentially determining variables such as: reported frequency of seeing other, and emotional attitudes toward the others.

The subjects were 67 female student nurses who rated themselves on ten traits generally measuring self-esteem. The average deviation of self-ratings was used as a measure of variability of the self-concept. Each subject also designated the classmate who was: most nearly her psychological twin, or para-type (P); least likely her psychological twin, or contra-type (C); and the one she wished privately to be most like, or ego ideal (E). Each S rated her P, C, and E on the same ten traits and also indicated her degree of liking, understanding, and the frequency of seeing these selected others. All S's were administered the Inventory of Factors GAMIN.

Perceptual facility was measured by: (a) tachistoscopic recognition thresholds of photographs of five faces: self (S), P, C, E, and a well-known movie star (M); (b) ratings and a rank ordering of clarity of recall of these faces.

As predicted, the S face was found in general more difficult to perceive than other faces. For example, the S face was significantly less recognizable than the M face at the 0.1% level of confidence. The correlation between difficulty of self-recognition and variability of self-concept was in the predicted direction but was significant ($P=.05$) only after elimination of subjects judged on other criteria as "rigid." The prediction that the more maladjusted persons would experience greater difficulty in facial self-perception was not borne out for the range of personality adjustment represented in this sample.

Facility in facial perception of P, C, and E faces was found to be not significantly related to either variability of perceiver-ratings of P, C, and E on the ten traits, or to the reported frequency of seeing these selected others. For P and E faces, generally significant correlations were found between measures of perceptual facility and rated liking. For C faces, the comparable correlations were not significant. For the three groups combined, recognition facility and liking correlated beyond the 1% level of significance. Since C's were relatively more disliked and were rated more variably on the liking scale, it was considered possible that the low correlations involving them may have been due to a tendency for perceptual facility to be greater for faces of persons rated at either extreme of the liking continuum.

It was concluded that women at least experience greater difficulty in facial self-perception than in perception of others whom they can identify. This difficulty is related to inconsistency or variability of self-concept.

Perception of the photographs of selected others, however, is not closely related to how variably they are appraised or to how frequently they are reported seen, but to how much they are liked. The latter variable is interpreted as important to self-consistency in being an emotional concomitant of perceptually expressed caution in

relating to life-orientations which could promote either self-integration or self-disintegration.

121 pages. \$2.00. Mic 57-2234

A PERCEPTUAL STUDY OF DEVIANT COGNITIVE PROCESSES IN SCHIZOPHRENIA

(Publication No. 21,070)

David William Merrell, Ph.D.
Michigan State University, 1954

The purpose of this study was to test certain hypotheses concerning schizophrenic cognitive functioning through the use of a new perceptual task. The hypotheses grew out of the assumption that schizophrenia involves a general behavior pattern aimed at reducing the amount of stimulation to which the schizophrenic individual must respond.

A perceptual task was designed comprising ten series of stimulus events. The ten four-card sequences were presented ambiguously by projecting them on a screen out of focus. Seven of the ten series were characterized by a fourth event in the series which was so drawn as to allow either a complete change in the meaning of the sequence, a preservation of the original meaning through the four cards, an isolation of the fourth card from the first three, or an avoidance of any response to the fourth card.

The responses to this task were scored according to the conceptual schema of extensiveness of perceptual units. The extensiveness of a perceptual unit was defined as, and measured by, the number of stimulus elements from the stimulus unit included in the perceptual unit.

On the basis of the assumption concerning the schizophrenic's basic need to limit stimulus situations, the following general hypothesis was formulated: The schizophrenic process involves a relative inability of the individual to organize stimulus values into extensive, flexible perceptual units, or conversely, a tendency of the schizophrenic individual to react to stimuli of various degrees of potential meaning by forming relatively limited, rigid perceptual units.

Two groups of subjects were used - fifty normals and fifty schizophrenics. The variables of age, education, and intelligence, as measured on the Wechsler Bellevue vocabulary scale, were controlled.

The results that were obtained suggest the following specific conclusions:

1. The perceptual units elicited in schizophrenics by stimulus events of varying degrees of complexity are more limited than those of normals: that is, they include fewer of the potential stimulus elements.
2. The perceptual units of schizophrenics are more rigid than those of normals: that is, they do not tend as often to change their responses in light of changing stimulus events.

In general, this study offers evidence to support the assertion that the cognitive disorder commonly found in schizophrenia involves a general tendency to restrict or limit the amount of stimulation to which the schizophrenic must respond, and that this is reflected in the limited

number of stimulus elements in the schizophrenic perceptual unit, and in the rigidity of that unit.

92 pages. \$2.00. Mic 57-2235

RELATIONSHIPS BETWEEN DEVELOPMENTAL EXPERIENCES AND CHOICE OF DEFENSIVE BEHAVIOR: STUDY II. FEMALES.*

(Publication No. 17,754)

Samuel Selzer, Ph.D.
University of Houston, 1956

It was the purpose of this dissertation, one of two inter-related concurrent studies to explore areas of possible relationship between modes of defensive behavior in adults and early developmental experience of these adults, particularly within the family setting. The subjects for this study were 45 male (for Study I) and 45 female (for Study II) psychiatric patients referred for psychological evaluation at the University of Texas Medical Branch Hospitals in Galveston.

This study has attempted to provide some clarification of the meaning of defensive behavior by isolating some of the early developmental events associated with ultimate individual differences in choice of defense. Four defensive patterns--repressive, projective, intellectualizing, and defense by denial--were used under the assumption that most defensive activities can be subsumed under these headings.

The criterion measure employed for determining an individual's defense pattern was an adaptation of Schafer's system of classifying defensive operations based upon an analysis of Rorschach protocols. Three clinical psychologists, all familiar with Schafer's method of classifying defenses by means of Rorschach indicators (scores, themes, test attitudes), rated each of the Rorschach protocols; where there was unanimous agreement as to the defensive pattern used, the subject was included in the sample. It was found that very few male deniers and very few female projectors were isolated in the sample. This led to the hypothesis that one might be the culturally determined sex-role counterpart of the other. Consequently, the male sample included only intellectualizers, repressives and projectors, and the female sample was composed of only intellectualizers, repressives and deniers.

The predictor measure selected as a source for information regarding developmental experience was an interview schedule which was individually administered. This schedule was a compilation of material obtained from several sources.

A relatively large number of hypotheses were formulated which were divided into two classes--general and specific. The general hypotheses were intended as preliminary tests of the validities of a number of speculations, biases, and preconceptions about the developmental experiences and/or resulting behavior traits of the defensive groups used. The specific hypotheses were drawn a priori as implications of the appropriate general hypothesis. The broad areas of inquiry for which hypotheses were formulated included experience and developmental conditions (e.g. socio-economic level of family of orientation), interpersonal relationships (e.g. identification with father,

mother, etc.), attitudes of the family (e.g. towards customs such as smoking, entertainment such as dancing, institutions such as educational goals), self (e.g. attitudes of the subject towards achievement, aspirations, etc.) and special areas for the projective group (e.g. secretiveness, hostility, and aggression).

The interview schedule was administered only to those subjects whose Rorschach protocols were unanimously agreed upon by the three raters as to the specific defense pattern employed. Wechsler-Bellevue Intelligence Test scores were also obtained from the customary psychological test battery administered to the patient on his referral for psychological examination.

Steps in the analysis of the interview schedule data included scaling each of the responses to interview questions on the basis of the number of possible consistent discriminations; scoring of the items according to this system of scaling; determining directionality for each of these scaled items; converting each of the item scales into a standard scale; arranging clusters of items to make up rational scales representing various areas of developmental experience; conducting a rough item analysis for each of the rational scales; and employing a modified median test to test systematically hypotheses of relationship between defensive choice and developmental experience.

The most salient finding of this study was the definitive separateness of developmental experiences between the intellectualizing and the repressing groups in which the sex of the subject apparently played no differentiating role. In the area of experience and developmental conditions, the socio-economic level of the family emerged as the most important determinant of defensive choice, regardless of sex. The intellectualizer, both male and female, perceived the family environment as abounding in material ease and comfort. Further, the intellectualizer, regardless of his sex, had a higher level of education, was more intellectually curious, had wider interests, and was more prone than the repressive to change behavior patterns and attitudes during the several developmental stages.

In terms of interpersonal relations, the intellectualizer of both sexes identified with both parents to a greater degree than the repressive, and yet reported having more difficulty (e.g. friction, conflicting attitudes etc.) with them. In general, the repressive of either sex had a great deal more trouble with various aspects of life experience--more difficulty with school work as well as difficulty in relations with teachers and classmates, more problems pertaining to health, and less ability to get along with peers. The repressive was more easily led had more trouble in adjusting to non-family authority figures, and in general had fewer satisfactory interpersonal relationships.

The attitudes of the families of repressives were also consistently different from those of the intellectualizers, regardless of the sex of the subject. Parents of repressive subjects were less liberal and open-minded, granted less freedom and independence, encouraged their children less toward independent, unilateral courses of action with the apparent result that repressives were not prone to use their discretion in such ordinary activities as spending or saving money, smoking, going to church, etc. Parents of intellectualizers generally gave their offspring freedom of choice as to recreation, entertainment and leisure activities, and in general had fewer objections or prohibitions. Another common finding among the intellectualizers of both sexes was that their parents were reported as

administering punishment more severely and consistently than was true of the reported practices of the repressive parents.

In the area of self attitudes, the intellectualizer of each sex had a much wider range of interests, and a level of aspiration which was at the same time more realistic in the sense that he experienced greater accomplishments than did the repressive.

In considering the original contention that the male projector might be the culturally determined sex-role counterpart of the female denier, not much was found in the study which would support this as a definite conclusion. However, the facts still remain that few male deniers and female projectors were found, the female denier group and the male projector group did share some common developmental experiences and they showed almost completely opposite manifestations of behavior in many areas which might indicate differences in "reaction formation". It may well be that our present techniques of investigation may not be sensitive enough to pick up the essential similarities between these two groups. 155 pages. \$2.05. Mic 57-2236

*Please see Publication No. 17,753, B. A. Weiss, on page 1392 for Study I.

SOME DETERMINANTS OF POLITICAL ACTIVITY AMONG LIBERALS

(Publication No. 21,129)

Paul Stark, Ph.D.
Columbia University, 1957

Chairman: Edward J. Shoben, Jr.

The purpose of this study was to investigate personality differences between politically active and inactive liberals.

The guiding theoretical formulation of the research was that there was a considerable percentage of liberals who were possessed of rigid and punitive consciences which would not allow them to accept their own social and economic strivings. For such people the desire to right wrongs and to help others would be based on a need to assuage guilt. The presence in political clubs of people who were combining personal ambition with political belief would be distasteful to these people and would cause them to avoid organized political action. Furthermore, politics in a democracy requires compromise on some issues in order to make gains on others. A person with a punitive conscience could not make these compromises and this would be another reason for non-participation for these people. As a corollary of a punitive conscience it was hypothesized that the politically inactive liberal would be characterized by psychological defensiveness.

Two additional hypotheses were tested. The first was that active liberals would be more extraverted than inactive liberals. The second was that the families of politically active liberals would be more active politically than the families of inactive liberals.

The hypotheses were tested by means of a questionnaire containing a measure of Politico-Economic Conservatism; a test of Socio-Economic Values; a measure of Introversion-Extraversion; a measure of psychological defensiveness;

and three scales of conscience types, the moralistic-repressive conscience, the non-integrated conscience, and the integrated conscience. An additional questionnaire elicited information about family political activity.

The subjects were two groups (sixty in each) of active and inactive liberals. The groups were equated for age, sex, education, occupational status and degree of liberalism.

The results indicated that politically inactive liberals were characterized by more repressive and less integrated consciences than the active liberals. The inactive liberals, contrary to the hypothesis, had significantly higher socioeconomic values than the active liberals. Politically inactive liberals had a lower percentage of politically active people in their immediate families. The difference was slight in the case of men and larger in the case of women.

The test used to measure psychological defensiveness was the MMPI L6 scale. An analysis of the scale's correlation with the other tests in this study, and of the K scale (a 30-item scale, 22 items of which comprise the L6 scale) in other studies, suggests that this scale is a measure of ego strength rather than defensiveness. The hypothesis that inactive liberals are more defensive than active liberals was therefore not considered to have been tested in this research. The inactive liberals scored significantly lower on the L6 scale than did the active liberals.

The results obtained were related to Lasswell's work. He saw political activity as motivated by a need to compensate for a weakened ego. He hypothesized that as a child the politically active person experienced severe deprivation alternating with indulgence. Without indulgence the ego would be so damaged that acquiescence rather than striving for power would result. Because of the compensatory nature of his motivation Lasswell expected the politically active person to be more selfish than the inactive.

Lasswell's theory of personality development is Freudian and supposes that cooperative behavior is a sublimation of more basic destructive impulses. Another point of view, proposed by Suttie, sees a need to cooperate with others stemming from the infant's need for the mother as the basic human need. Our findings, which show a correlation between ego strength and selflessness support the latter view.

86 pages. \$2.00. Mic 57-2237

THE RELATIONSHIP OF SUCCESS AND FAILURE TO THE RECOGNITION AND EVALUATION OF SELF-PRODUCTS BY NORMAL AND SCHIZOPHRENIC SUBJECTS

(Publication No. 21,131)

Daniel A. Sugarman, Ph.D.
Columbia University, 1957

The present study attempts to determine the effects of atmospheres of failure and success upon the subsequent rating of one's self-product and the readiness to recognize it.

Sixty normal and sixty schizophrenic subjects were randomly placed into success, failure and control groups. The experimental procedure required each subject to be seen for two sessions.

In the first session, the subject made his self-product (i.e. Figure drawing, Bender designs, Handwriting, Original

design, and Coloring) subject to the experimental conditions. Subjects in the failure group made their products with interpolated failure experiences (i.e. withholding of cigarettes) on the subtests of the Wechsler-Bellevue Intelligence Scale. Subjects in the success groups made their products with interpolated success experiences (i.e. awarding of cigarettes) on the subtests of the Wechsler. The subjects in the control groups made their self-products without any interpolated experience.

During the second session, which was exactly one week later, the subject was asked to rank and to attempt to recognize the products that he had made the previous week. This second session was conducted under sub-optimal illumination.

The following results were obtained:

1. Both normal and schizophrenic subjects who made their products in an atmosphere of failure take longer to recognize their products the following week than subjects in either the success or control groups. Subjects in the failure groups also rate their products more negatively than subjects in either the success or control groups.

2. Normal subjects in the success group do not significantly differ from subjects in the control groups in subsequent recognition or rating of self-products. Contrary to the prediction, schizophrenics in the success group take significantly longer to recognize their products than subjects in the control group.

3. Under neutral conditions, schizophrenics do not recognize or rate their products differently from normals.

4. Wolff's major hypotheses were supported in the study.

- a. In a normal group, judgment of one's own unrecognized product is more extreme than judgment of one's own recognized product.

- b. Judgment of one's own product under neutral conditions is usually positive.

These results were interpreted as supporting Wolff's hypothesis that people, on occasion, do not recognize either some aspect of themselves or something that they have made because that object or aspect has become associated with unpleasant experience.

It was held that although a perceptual defense explanation of these results is suggestive, the elevated recognition times of subjects in the failure groups could be explained by more classical concepts (i.e. as a result of the conflict produced by an approach-avoidance situation). The results of this study, if verified upon replication and elaboration, would call for a clearer definition of the role played by incidental learning in this and other perceptual studies which employ recognition as a variable.

Suggestions for future research centered on defining further specific atmospheres that would either inhibit or facilitate self-recognition and the need for further evaluation of the many hypotheses generated by the present study.

Implications concerning the psychoanalytic conception of schizophrenia and Bruner's concept of self-salience were also discussed.

96 pages. \$2.00. Mic 57-2238

RELATIONSHIPS BETWEEN DEVELOPMENTAL
EXPERIENCES AND CHOICE OF DEFENSIVE
BEHAVIOR: STUDY I. MALES.*

(Publication No. 17,753)

Bertram Arthur Weiss, Ph.D.
University of Houston, 1956

It was the purpose of this dissertation, one of two inter-related concurrent studies, to explore areas of possible relationship between modes of defensive behavior in adults and early developmental experience of these adults, particularly within the family setting. The subjects for this study were 45 male (for Study I) and 45 female (for Study II) psychiatric patients referred for psychological evaluation at the University of Texas Medical Branch Hospitals in Galveston.

This study has attempted to provide some clarification of the meaning of defensive behavior by isolating some of the early developmental events associated with ultimate individual differences in choice of defense. Four defensive patterns--repressive, projective, intellectualizing, and defense by denial--were used under the assumption that most defensive activities can be subsumed under these headings.

The criterion measure employed for determining an individual's defense pattern was an adaptation of Schafer's system of classifying defensive operations based upon an analysis of Rorschach protocols. Three clinical psychologists, all familiar with Schafer's method of classifying defenses by means of Rorschach indicators (scores, themes, test attitudes), rated each of the Rorschach protocols; where there was unanimous agreement as to the defensive pattern used, the subject was included in the sample. It was found that very few male deniers and very few female projectors were isolated in the sample. This led to the hypothesis that one might be the culturally determined sex-role counterpart of the other. Consequently, the male sample included only intellectualizers, repressives and projectors, and the female sample was composed of only intellectualizers, repressives and deniers.

The predictor measure selected as a source for information regarding developmental experience was an interview schedule which was individually administered. This schedule was a compilation of material obtained from several sources.

A relatively large number of hypotheses were formulated which were divided into two classes--general and specific. The general hypotheses were intended as preliminary tests of the validities of a number of speculations, biases, and preconceptions about the developmental experiences and/or resulting behavior traits of the defensive groups used. The specific hypotheses were drawn a priori as implications of the appropriate general hypothesis. The broad areas of inquiry for which hypotheses were formulated included experience and developmental conditions (e.g. socio-economic level of family of orientation), interpersonal relationships (e.g. identification with father, mother, etc.), attitudes of the family (e.g. towards customs such as smoking, entertainment such as dancing, institutions such as educational goals), self (e.g. attitudes of the subject towards achievement, aspirations, etc.) and special areas for the projective group (e.g. secretiveness, hostility, and aggression).

The interview schedule was administered only to those subjects whose Rorschach protocols were unanimously agreed upon by the three raters as to the specific defense pattern employed. Wechsler-Bellevue Intelligence Test scores were also obtained from the customary psychological test battery administered to the patient on his referral for psychological examination.

Steps in the analysis of the interview schedule data included scaling each of the responses to interview questions on the basis of the number of possible consistent discriminations; scoring of the items according to this system of scaling; determining directionality for each of these scaled items; converting each of the item scales into a standard scale; arranging clusters of items to make up rational scales representing various areas of developmental experience; conducting a rough item analysis for each of the rational scales; and employing a modified median test to test systematically hypotheses of relationship between defensive choice and developmental experience.

The results indicated that there was a definite relationship between each of the characteristic types of defensive behavior and the individual's early developmental experiences. A large proportion of the hypotheses concerning the relationship between developmental experiences and choice of defensive behavior were confirmed at levels of confidence varying from .05 to .001.

Some of the more significant developmental experiences unique to the intellectualizers included the higher socio-economic conditions of the family; a perception of family environment as having more ease and comfort; less overall difficulties in dealing with organizations, institutions, and various groups of people; an experiencing of more change in environmental conditions and greater shifts in attitudes during the periods from childhood to adolescence and from adolescence to adulthood; greater identification with family in general and a strong identification especially with the father figure; and a perception of their families as demonstrating more tolerant attitudes towards customs, entertainment, recreation, institutions, and towards the subjects themselves. Further, the intellectualizers had more varied interests, higher aspirations, greater achievement, and a higher intelligence quotient than the other groups.

There was considerably less to distinguish the repressive, as contrasted with the intellectualizer, in terms of unique factors. They tended to be at the low end of the socio-economic scale. They were more involved emotionally with their religious activities, and came from a fundamentalist background more frequently than the other two groups; they identified more with the mother figure; they had the greatest amount of difficulty in relating to non-family authority; they perceived their family figures as indulging them more when sick; and they perceived their parents as being more liberal in their attitude towards punishment. They also had the lowest intelligence quotients of the three groups.

Relatively few findings were unique to the projective group except that they were found to have the greatest amount of turmoil, aggression and hostility occurring within their developmental experiences.

The results of the study indicated that the projective group shared more factors in common with the repressive group than they did with the intellectualizing group. At the same time there were enough unique characteristics within

each of these two groups to warrant their continued separation as different defensive operations.

151 pages. \$2.00. Mic 57-2239

*Please see Publication No. 17,754, Samuel Selzer, on page 1389 for Study II.

PSYCHOLOGY, EXPERIMENTAL

FACTORS OF MOTOR SKILL LEARNING AS RELATED TO CONTROL LOADING

(Publication No. 21,422)

Nancy Sagrid Anderson, Ph.D.
The Ohio State University, 1956

The study investigated the factors influencing motor skill learning as related to control loading parameters. Since most of the research to date on tracking studies has used a single measure of tracking performance, 12 measures of performance were used in the study in order to give a more complete description of the response processes involved in motor movements.

A simple sine function input (10 cycles per minute) was chosen as the input for a compensatory tracking task. Data were collected on 100 male subjects who were divided into four groups of 25 each for the following control parameter conditions: (a) free control, (b) spring-centered control (160 inch-pounds per degree of movement), (c) mass-added control (inertia, $J = .484$ foot-pounds per second²), and (d) spring-and-mass-combined control (natural frequency of the system equal to 2 cycles per second).

The following 12 measures were taken on all subjects during each of ten 90-second trials: integrated error squared, constant error, three time-on-target scoring bands, three transition band crossing scores, integrated squared derivative of error, algebraic derivative of error, a slope measure from the autocorrelation of error, and an input power measure from the autocorrelation of error.

Each score was averaged for the 25 subjects in each condition. The 40 trials (10 trials for each condition) were intercorrelated ($N = 12$ measures), and a factor analysis resulted in seven orthogonal factors with significant loadings.

Two of the factors are general skill factors, one a high-accuracy skill factor and the other a medium-accuracy skill factor. Both of these factors reflect the superiority of performance when spring stiffness is added to the control. The other five factors reflect different specific response patterns found during the learning stages when a given control loading was added. These factors also show that when spring stiffness is added to the control, a more rapid movement leads to higher frequencies in the error, and in general is a quicker correcting response than that found in the slower and smoother movement with the free control. However, the free-control and spring-loaded-control movements are alike in that both lead to a lower constant error than that found in the mass-loaded or spring-and-mass-combined control.

The mass-loaded control results in a movement pattern

leading to the poorest accuracy of the four conditions. The only accuracy achieved is movement within a wide tolerance zone, and responses still reflect the highest constant error of the four conditions. The pattern of scores implies that the inertia of the stick results in overshoots or undershoots, making it difficult to stay in a narrow accuracy zone, and that responses are asymmetrical for flexor and extensor movements.

Results are in agreement with those of others who find increased accuracy with spring stiffness added and poorest performance with a mass-loaded control. Results show that caution is needed in the interpretation of changes due to practice or control parameters when a single measure of performance is taken, since in this study all control parameters indicate differences in patterns of movement even at the final stages of practice. An explanation of some conflicting results in the literature about control parameters is explained by measures chosen in the previous studies.

Results have implications for efficient training procedures, which might include emphasis on particular response patterns desired for a given control movement.

62 pages. \$2.00. Mic 57-2240

THE EFFECTS OF MODERATE AND LOW LUMINANCES AND VARIOUS DURATIONS OF PRE-EXPOSURE ON DARK ADAPTION

(Publication No. 21,113)

Dorothy Elvira Fletcher, Ph.D.
Columbia University, 1957

Dark adaptation data were obtained for each of two observers after pre-exposure to moderate and low luminances and various durations. The pre-exposure and test fields were presented monocularly by means of a modified Hecht-Shlaer adaptometer with an artificial pupil that was 2 mm in diameter. Absolute thresholds for the test field luminance were obtained by means of ascending series of the method of limits.

After 30 minutes in the dark, each observer was exposed to a white field, 35° in diameter, located 10° nasally on the retina of the left eye, with luminances of from 0.000608 to 971 mL combined with durations of from 0.01 to 20 minutes. Dark adaptation data were obtained following the pre-exposure with a test field that was green, 1° in diameter, located 10° nasally, and exposed for 0.02 second.

The dark adaptation data could be fitted with single-limbed curves within a range of products of pre-exposure luminance and duration of from -1.15 to 2.69 log mL-min for one observer and from -1.92 to 2.99 log mL-min for the other observer.

Over this range, it was concluded that there was a slight decrease in the acceleration of the dark adaptation curves as the product of pre-exposure luminance and duration increased and to a lesser extent as the pre-exposure duration increased.

Over this same range, the effect of an increase in the logarithm of the product of pre-exposure luminance and duration was to increase approximately linearly the extent of the dark adaptation curve on both the time axis and the log threshold luminance axis, except that relatively long

and short pre-exposure durations had, respectively, more or less effect upon the extent on either axis of the subsequent dark adaptation curve.

49 pages. \$2.00. Mic 57-2241

PERCEPTUAL DEFENSE AS REVEALED BY NORMAL
AND CLINICALLY REFERRED SUBJECTS IN
RESPONSES TO THREE CLASSES
OF PICTORIAL STIMULI

(Publication No. 21,301)

Helaine Lois Moody, Ph.D.
Purdue University, 1957

Major Professor: Lawrence M. Baker

This experiment was performed to study perceptual defense as revealed by raised recognition thresholds to pictorial stimuli judged as unpleasant in comparison to pleasant or neutral stimuli and when comparing two groups of subjects. Children who had been referred to Child Guidance Clinics for psychological problems made up the Experimental group while normal, i.e., non-referred children made up the Control group. Two threshold levels, a visual (non-verbal) and interpretive (verbal) were used to study the role of verbalization in perceptual defense. There were two types of pictorial stimuli, photographs and drawings. The drawings were designed to control for such factors as differences in general structure, shading and contrast. Three classes of stimuli were compared: pleasant, neutral, and unpleasant.

It was hypothesized that perceptual defense would occur as manifested by raised recognition thresholds to unpleasant stimuli as compared to pleasant and neutral stimuli in both groups but with the Experimental group showing a greater amount of perceptual defense. It was predicted that pleasant stimuli would have the lowest thresholds, neutral the next lowest, and unpleasant the highest. It was further hypothesized that the Experimental group would have lower thresholds to pleasant stimuli than the Control group and higher thresholds to the unpleasant stimuli than the Control group. It was also hypothesized that perceptual defense would occur at both threshold levels and that it would not be affected by the type of stimulus.

Each group was composed of 16 subjects matched for age, sex, and race and similar in grade, intelligence, and socio-economic status. Their ages ranged from 8 to 12 years. The apparatus consisted of a visual stimulus box constructed so that the subject could regulate the amount of light needed to see the stimulus. The stimuli were selected on the basis of judges' ratings and consisted of 5 photographs and 3 drawings for each category. Each subject was tested individually and required to set two thresholds for each picture. For the visual level the subject was required to set a threshold where he could just barely see the stimulus. At the interpretive level he was required to set a threshold where he could be sure of the stimulus and report what was happening in the picture. The results of the experiment were analyzed using an analysis of variance technique. Tests of significance of difference between means were also calculated.

It was found that, in general perceptual defense occurs,

as indicated by raised recognition thresholds, in the perception of unpleasant stimuli. A greater amount of perceptual defense occurs when the subject is required to verbalize and interpret the stimuli. The clinically referred subjects differed significantly from the Control subjects at the visual threshold level. At this threshold the Control group does not show perceptual defense to unpleasant stimuli. However, at the interpretive threshold both groups show perceptual defense and do not differ significantly. The hypothesis that the Experimental group would have lower thresholds to pleasant stimuli than the Control group was not supported.

It was also found that the type of stimulus has some effect on recognition thresholds. Thresholds for photographs of neutral and unpleasant stimuli rise more sharply at the interpretive level than the thresholds for drawings.

The predictions that pleasant stimuli would have the lowest threshold, neutral the next lowest, and unpleasant the highest were partially supported. The means of the pleasant stimuli differed significantly from the means of the unpleasant stimuli in all tests made. However, the means of the neutral stimuli did not differ significantly from the pleasant or unpleasant stimuli.

96 pages. \$2.00. Mic 57-2242

INHIBITORY POTENTIAL AND THE EFFORT
VARIABLE IN A PERCEPTUAL PSYCHOMOTOR TASK

(Publication No. 21,225)

Ambalal Somabhai Patel, Ph.D.
The University of Wisconsin, 1957

Supervisor: Professor David A. Grant

A consistent and satisfactory picture of the effort-inhibition relationship as deduced from Hull's inhibitory constructs has not been developed. The present investigation was an attempt to examine this effort-inhibition relationship by manipulating a response-dependent effort in a perceptual psychomotor learning task.

One hundred and twenty men and one hundred and twenty women subjects from the introductory psychology class at the University of Wisconsin provided data for the investigation. The apparatus used was a modified multiple serial discriminator (MSD). The task for the subjects was to match stimulus lights with response lights by pressing appropriate keys. By varying the pressure required to depress the key and also the degree of distribution of practice, the experiment was conducted employing a factorial design ($4 \times 3 \times 2$) to study four levels of effort; viz., 200, 400, 600 and 800 gms.; three degrees of distribution of pre-rest practice; viz., 0 sec., 30 sec. and 60 sec. intertrial interval, and the sex of subjects, male and female. Twenty subjects--ten men and ten women--were randomly assigned to each of 12 conditions.

The training session consisted of 20 trials. On each trial the subject had to match 16 randomly appearing lights one by one under one of the 12 conditions. Then followed a rest interval of 10 min., after which there were five more test trials on the same set-up of lights but with the 200 gms. effort and 60 sec. distribution of practice, regardless of pre-rest condition. The time and error scores

for each trial provided data for the analyses. The results warranted the following conclusions:

1. Recovery from inhibitory decrements accumulating during practice was measured during post-rest performance, and found to be directly related to the degree of massing of practice during training trials.

2. Women showed greater average recovery than men; however, interaction of sex and degree of distribution and effort as well as the warmup decrements complicated the findings. With the greatest distribution of practice, women showed less recovery than men at the lowest level of effort, while at the highest level of effort in distributed practice recovery showed no sex differences. This was attributed to differential tolerance of effort by men and women.

3. The effects of the effort variable on recovery were found to be obscured by warm-up decrement on the first post-rest trial. On eliminating these warm-up decrements, it was found that recovery was clearly an increasing function of the effort actually expended during the pre-rest practice. However, the two lower levels (200 and 400 gms.) of effort did not differ significantly in their effect on recovery.

4. Warm-up decrements were progressively greater following the higher amounts of effort during pre-rest practice, particularly in the most distributed practice condition. At other degrees of distribution the 400 gms. effort groups, curiously enough, showed the least warm-up decrement. The possibility of expending more effort at the lowest level or under the tension of the massing of practice, etc. might have prevented the lowest effort level from producing the least warm-up.

5. Warm-up decrement was an inverse function of the degree of distribution during pre-rest practice.

6. Men showed greater warm-up decrement at the two lower levels of effort and women showed greater decrement at the two higher levels of effort. This, apparently, explained the lack of significant sex differences in warm-up decrements. It was conjectured that although women had an advantage of acquired set from similar tasks at lower levels of effort, the sex differences in strength predominated at higher levels of effort.

7. The acquisition curves showed the usual striking relation to the degree of distribution of practice; massed practice was the least favorable to superior performance.

8. Although there were no significant over-all sex differences in pre-rest and post-rest performances, it was observed that women were superior in the earlier part of training, while men maintained superiority in later stages of pre-rest learning.

9. The effort variable did not seem to have any significant influence on acquisition, although the 800 gms. groups tended to be at a disadvantage and, curiously, the 400 gms. group was superior in pre-rest and post-rest performances. It is possible that increased motivation might have compensated for any impediment due to effort. However, in spite of this lack of difference due to effort in pre-rest learning, the post-rest recovery was a function of effort involved. This would be interpreted by Hull to mean that the greater degrees of effort during practice were accompanied by greater accumulation of inhibitory decrements.

63 pages. \$2.00. Mic 57-2243

AVOIDANCE CONDITIONING IN THE ABSENCE OF EXTERNAL STIMULATION: SOME EXPERIMENTAL AND GENETIC PARAMETERS

(Publication No. 20,888)

Vernon Herbert Schaefer, Ph.D.
University of Illinois, 1957

Another investigator had shown that albino rats are able to learn to avoid shock in the absence of any external warning signal. (Observationally, and, to some extent, psychologically, the behavior of a rat that has learned to do this is very like that of a compulsive human being.) This finding was counter to that of an earlier experimenter. A theoretical analysis seemed to indicate that this conflict in results was due to a difference in the length of the time intervals between shocks used in the two procedures. It was posited that rats can learn to avoid shock when there is no danger signal only if the intervals between the end of one shock-escape or -avoidant response and the onset of the shock-to-follow are less than, roughly, thirty seconds. This followed from two considerations. One was the hypothesis that the basis for this kind of learning is the conditioning of fear to a point on the stimulus traces produced by a previous shock and/or a prior response. The other was the rather well-substantiated probability that stimulus traces disappear within about thirty seconds of their inception.

Experiment I of this dissertation was designed to ascertain the limiting temporal conditions for the occurrence of avoidance conditioning in the absence of a warning signal. Hooded rats were used as subjects. The results were both negative and inconclusive, negative in that a few of the animals that were not expected to learn actually did so, inconclusive in that very few of the animals for which learning was predicted actually did meet the learning criterion. A new hypothesis which would account for the first of these two results was then developed. This hypothesis was that the basis for learning is the conditioning of fear to that total experimental situation which exists when shock is applied, i.e., when the performance of the last escape or avoidant response has ended some time ago.

Experiment II was then designed to test this hypothesis. The results, however, were only mildly confirmative, since very few of the subjects (hooded rats) learned to criterion. It was then further postulated that there might exist strain differences in rats in the ability to learn in the kind of situation investigated. The basis for this was the finding of differences between strains in several pilot studies.

Experiment III was then designed to test whether such strain differences actually do exist. It was found that black rats are very significantly superior to both albinos and hoods in the kind of learning studied in this thesis. This finding is discussed as a valid reason for psychologists to take more cognizance of the importance of genetic differences. It is speculated that the superiority of the black rats may be based on their much higher spontaneous activity level (demonstrated in an independent test). Experiment III also provided definite confirmation of the hypothesis which Experiment II attempted to test.

In Experiments II and III some attempt was made to obtain evidence on the questions of whether cues contiguous with shock termination acquire reinforcing properties, and whether such cues come to serve also as discriminant

stimuli. However, methodological difficulties made impossible any answers to these questions.

101 pages. \$2.00. Mic 57-2244

A STUDY OF ADRENAL CORTICAL ACTIVITY AND PERFORMANCE ON A STRAIGHT RUNWAY IN RATS SUBJECTED TO STARVATION

(Publication No. 18,040)

Ralph Frederick Strebel, Jr., Ph.D.
Syracuse University, 1956

The purpose of this experiment was to employ food deprivation schedules which would differentiate between two groups of animals in terms of their motivation and performance in a simple behavioral situation and to determine the relative degree of stress produced in the two groups in terms of the blood eosinophil level and the histological changes in the adrenal cortex.

Forty-eight male Wistar albino rats approximately 120 days old with a mean body weight of 321 grams were used. The 29 animals in Group I were randomly divided into a high drive subgroup of 15 animals and a low drive subgroup of 14 animals, while the 19 animals in Group II were randomly divided into a normal control subgroup of four animals, a high drive subgroup of seven animals, and a low drive subgroup of eight animals. At the end of the 38-day experiment, four high drive animals and three low drive animals from Group I were randomly selected and autopsied so as to increase the volume of the histological data. Group I was used for the purpose of collecting weight loss, eosinophil, and running speed data, while Group II was used for histological purposes only.

Both major groups were maintained in the same manner except that in the case of Group II, simple bleeding was substituted for eosinophil counts and handling was substituted for weighing and running speed trials. All high drive animals were maintained on 5 gms. (dry) of chow per day, while all low drive animals were maintained on 20 gms. (dry) of chow per day. The four normal control animals in Group II were maintained on an ad lib diet and were sacrificed before the onset of deprivation so as to provide normal control adrenal histological sections.

Statistically significant differences between the high and low drive groups were found for body weight loss, running speed, and the eosinophil level. Both types of starvation employed in this experiment resulted in increased running speed. However, the increased running speed in the high drive group was more pronounced than in the low drive group. The starvation schedules for both the high drive and low drive groups produced progressive increases in the eosinophil levels through the third blood count. After that point in time, the severe starvation regimen was associated with a progressive decline in the eosinophil levels, while the mild starvation regimen was associated with continuously high eosinophil levels. Animals whose eosinophil levels decreased to or fell below the basal eosinophil value tended on the average to be faster in running speed as compared to animals that maintained a relatively constant eosinophil level high above the basal value. Adrenal cortical histological changes were not outstanding except on the 28th day of deprivation when

cystolysis and nuclear pyknosis were observed in all of the high drive animals. Since three out of these four animals also displayed lipid depletion, these changes indicate that the adrenals of these animals were hyperactive. The results indicate that food deprivation schedules used in behavior studies produce stress effects. The increased eosinophil levels observed in the low drive group indicate adrenal cortical hypoactivity and less glucocorticoid than normal. The decline of the eosinophil levels of the high drive group from the fourth through the eighth blood count indicates a gradual tendency toward increased adrenal cortical activity in spite of the fact that the eosinophil levels were above the basal value. In the high drive group, the drop of the eosinophil level below the basal value on blood counts nine through eleven indicates an adrenal cortical activity which was greater than normal and, therefore, the glucocorticoid level in these animals was greater at that time.

81 pages. \$2.00. Mic 57-2245

CONTRAST, ASSIMILATION, AND THE CENTRAL TENDENCY EFFECT

(Publication No. 21,370)

William Arthur Watson, Ph.D.
University of Michigan, 1956

Previous studies in psychophysics have found that when subjects make judgments about a series of stimuli which vary in magnitude, the judgments made to any one stimulus are affected by the other members of the series. Specifically, it has been found that large stimuli relative to the series tend to be judged smaller after a short time interval and small stimuli relative to the series tend to be judged larger. This phenomenon has been called the "central tendency effect." Two theories have been proposed to account for this effect, the contrast theory and the assimilation theory.

The purpose of the present study was twofold: (1) to investigate experimentally the psychological magnitudes of stimuli and stimulus traces as they occur in the central tendency effect, with special reference to the contrast and assimilation theories of that phenomenon and, (2) to examine the comparability of assimilation and contrast as they operate in the central tendency effect and other examples of assimilation and contrast.

Three experiments were carried out in all. In each, subjects made judgments on one or more series of circular stimuli which varied in size. The method of constant stimuli was employed, using two comparison stimuli for each standard with a five-second time interval between standard and comparison presentations.

The purpose of Experiment 1 was to test for a reversal of the central tendency effect for stimuli lying outside the expected range. To accomplish this, subjects were familiarized with a series of stimuli displaying a limited range of sizes. Then test stimuli were presented which were considerably larger (or smaller) than the original series. Results indicated no such reversal was present.

In both Experiments 2 and 3, one purpose was to determine if perceptual grouping of the stimuli involved would yield more than one central tendency effect. In these experiments, one group of four standards was presented high

in the visual field and was of one color, while another group was presented low and was of a different color. In Experiment 2 the two series differed considerably in size, whereas in Experiment 3 the two series overlapped in size. The results, although not clearly discriminating between one or two central tendency effects, do suggest some influence resulting from the cognitive classification of the stimuli involved.

Experiment 2 also tested for the presence of a contrast effect for stimuli lying outside the expected range. To this end, size judgments were made on two stimuli presented simultaneously. These stimuli were equal in size and each represented one of the original series in both position and color. The stimuli lay between the two series in size, one being distinctly smaller than the large series and the other being distinctly larger than the small series. The results indicated the presence of a contrast effect.

Experiment 3 also tested for the presence of an immediate assimilation effect for stimuli within the series range. To test for this, judgments were made under circumstances identical to those of Experiment 2 except that in this case the simultaneously presented stimuli were taken from the range of sizes where the two series overlapped. The results again indicated the presence of a contrast effect, rather than assimilation.

On the basis of these results and other considerations it is concluded that: (1) The mechanism underlying the central tendency effect appears to involve an immediate contrast effect followed by a gradual assimilation of the stimulus trace toward the average value of the series, (2) for stimuli lying outside the stimulus range there is a pronounced contrast effect which, however, does not increase in time, (3) although the central tendency effect appears to be influenced by cognitive groupings of the stimuli involved, it does not, in itself, provide a broad enough foundation for a general theory of class perceptions.

92 pages. \$2.00. Mic 57-2246

HYPNOTIC SUSCEPTIBILITY AS RELATED TO MASCULINITY-FEMININITY

(Publication No. 21,372)

André Muller Weitzenhoffer, Ph.D.
University of Michigan, 1956

This investigation was conducted to test the hypothesis that femininity and hypnotic susceptibility are positively associated. The hypothesis was derived from the broader Freudian theory that hypnosis is a transference manifestation in which the feminine masochistic component of the sexual instinct plays a dominant role.

A sample of 100 male and 100 female college undergraduates were administered a battery of five group tests. Three of these five were tests of masculinity-femininity: The Gough Femininity Scale from the California Personality Inventory, The Franck Drawing Completion Test, and the Terman-Miles Attitude-Interest Analysis Test. The other two tests were multi-factor personality tests each providing a measure of masculinity-femininity, as well as measures of several other dimensions of personality. During a subsequent individual session hypnotic susceptibility was evaluated by means of the Friedlander-Sarbin

induction technique and scale of depth of hypnosis. The maximum depth of hypnosis attained on one trial was used as a measure of hypnotic susceptibility.

In addition to controlling the possible influence of the subject's biological sex upon hypnotic susceptibility, a male and a female hypnotist were used to control the possible influence of the sex of the hypnotist. Each hypnotist tested the susceptibility of half of the male sample and half of the female sample.

At the termination of the hypnotic session each subject was asked to fill out a modified Gough test aimed at obtaining a measure of the subject's perception of the hypnotist's femininity.

In order to obtain additional data on the influence of the sex of the hypnotist, a small number of subjects was retested with respect to hypnotic susceptibility a month or more after the first test. This subgroup included both highly susceptible and non-susceptible subjects of each hypnotist, some of whom were retested by the same hypnotist and others by the opposite sex hypnotist.

It was found: (a) that the five femininity measures were relatively independent; (b) that the sample of women and men tested by each hypnotist were essentially equated with respect to femininity; (c) that the women and men samples respectively were also about equally susceptible to hypnotic induction by each of the two hypnotists; and (d) that the subjects showed little change in susceptibility when retested a month later by the same hypnotist or one of the opposite sex.

The present results indicate that neither the sex of the subject nor the sex of the hypnotist has any influence upon hypnotic susceptibility. In general, the findings provide no support for the hypothesis that the subject's femininity is positively associated with hypnotic susceptibility. Nor is there evidence that the femininity of the hypnotist as perceived by the subject has any influence on susceptibility.

It is concluded that femininity is not related to hypnotic susceptibility. While this does not necessarily invalidate the broader psychoanalytic transference theory of hypnosis, the findings infirm one hypothesis derived from this theory.

111 pages. \$2.00. Mic 57-2247

PERCEPTUAL STRUCTURING OF SEQUENCES OF STATISTICALLY DEPENDENT EVENTS

(Publication No. 21,374)

Leon Goff Williams, Ph.D.
University of Michigan, 1956

Several experimenters have found that in a sequential presentation of binary events subjects will predict that one of the two possible events will occur about as often as it actually does occur. Various statistical models have been developed in order to fit data from such experiments, the Bush-Mosteller model being a prime example. In an extension of the above type of experiment, J. E. K. Smith studied responses to sequences of events which contained more complex statistical structures. If a sequence is constructed so that the occurrence of the event at trial t is statistically dependent on the event that occurred at trial $t-k$, the responses at trial t were found to be dependent on the event at trial $t-k$. Smith applied the Bush-Mosteller

model to his data. Doing this implies the existence of specific types of statistical relationships between the events and the responses.

The purpose of the present study is to show that the characterization of the subjects' perceptions of the structure in a sequence will achieve a more adequate description and explanation of the response to the sequence. The major premise is that the statistical structure of a given sequence will lead the subjects to perceive the sequence in terms of specifiable repeated patterns. Employing techniques used in the study of probability processes, a method for describing a sequence and analyzing responses was developed.

Predictions were made to the character of responses within a series and to response differences for different series. The experiment consisted of presenting each subject with one of twenty-two sequences of stimuli. An automatic programming device illuminated one of two possible lights at each trial. All sequences, except for two, were 250 trials long, and from three to six subjects responded to each sequence. Subjects also described their perceptions of the sequence by responding to a short questionnaire.

The initial results disclosed that: (a) subjects did not respond solely to the repeated patterns; (b) when a series contained two patterns, the subjects responded more consistently to the simpler of the two patterns; (c) when the patterns in one series were simpler than the patterns in a

second series, the subjects responded more consistently to the former series; (d) the subjects' verbal reports indicated that they often perceived some structure in the series and that they responded on this basis.

The data from the Smith study and the present study were analyzed further in order to arrive at a more detailed understanding of the subjects' behavior. The perception of a given pattern in a given sequence sometimes is found to be inaccurate, incomplete, and dependent on the other structure in the sequence. The inaccuracies are in the direction of simplification of the pattern. Furthermore, only the simplest patterns are seen clearly, even when the statistical dependency is high. It is found also that there may be large individual differences in the perception and response to a given sequence. The final statement regarding the perception of the structure in a sequence is cast in terms of the repeated patterns and the run structure (the distribution of the lengths of homogeneous sequences of each stimulus). It was shown that a simple application of the Bush-Mosteller model will fit the data for only some of the series, and even then the fit is a gross one at best. It is concluded, therefore, that a phenomenological approach is a fruitful one for the understanding of the subjects' behavior.

Finally, the application of the method to the general case of sequences containing a statistical structure was discussed.

166 pages. \$2.20. Mic 57-2248

RELIGION

PROBLEMS OF RELIGIOUS KNOWLEDGE IN THE
THOUGHT OF ALBRECHT RITSCHL, WILLIAM
JAMES, AND H. RICHARD NIEBUHR

(Publication No. 21,109)

Russell Thorn Blackwood III, Ph.D.
Columbia University, 1957

The alleged noetic character of much religious experience requires inquiry into the epistemological methods and status of faith-statements. In contrast to the more traditional authoritarian, rationalistic, empirical, or intuitive analyses stands a broad and undefined approach which emphasizes the role of will in the gaining of religious knowledge. Although technically unrelated to a distinct "school," Albrecht Ritschl, William James, and H. Richard Niebuhr represent three, varying illustrations of the contention that religious "judgment" is clearly foundational to religious "knowledge."

Albrecht Ritschl's concept of the religious "value-judgment" proceeds from his earlier rejection of rationalism's efforts to prove the existence of God. The concept is founded on the argument that while "spirit" is an experienced reality, it is quite impossible for reason and that two forms of knowledge, "theoretic" (descriptive) and "religious" (valuational), must thus be possible. The concept is also supported by a theory of religion which contends that a valuational assertion of deity is required by the transcendent yearnings of the human spirit caught up

in the finite world of nature. Thirdly, the concept is supported by a brief reference to a "Lotzean" metaphysic expressing confidence in the reality of the phenomenal world. In criticism, the author suggests that while the concept of the "value-judgment" compels religious knowledge to begin with the immediate and the personal, Ritschl's exposition of it is burdened with contradictions which rob it of force. The various supporting arguments are hardly co-ordinate and are not argued consistently throughout. It is suggested that the precise noetic quality of the "value-judgment" is never made entirely clear and, finally, that Ritschl's theory of religion implies a strong anthropocentrism which is inadequate to religious experience.

William James's concept of "the will to believe" follows his analysis of traditional, rationalistic theories of religious knowledge as logically unacceptable, unable to meet the challenge of Darwinism, unable to describe the purposive character of knowledge, and morally objectionable. In James's view, the "faith-ladder" is a pragmatic supplement made necessary by the limits of empiricism. The author suggests that while many of the traditional criticisms of "the will to believe" are founded on a basic misunderstanding of James's purpose, the underlying pragmatism requires, in the last analysis, that "beliefs" stand merely as "justifiably cherished hypotheses" and that an assertion of their "truth" is quite misleading. It is also suggested that, in James's approach, the crucial question remains essentially untreated, *viz.*, the character of the "moral impulses" which justify belief.

H. Richard Niebuhr's understanding of "revelation" proceeds from his criticism of traditional apologetics as "defensive" and his acceptance of historical relativism. Revelation may be taken as a center of value which fills the personal life with meaning and, as the final intelligibility, makes the particulars of experience intelligible; as such, it is confessional and not apologetic in nature. In criticism, the author suggests that in several crucial passages Niebuhr implies that revelation can be validated, or at least that revelation can be distinguished from "false idolatry." It is suggested that such an implication is incompatible with a thorough historical relativism and with the description of the nature of revelation.

In general, the description of religious knowledge as thoroughly valuational requires a rigorous separation of "theoretic" and "religious" knowledge and would seem to imply a relativism of religious knowledge. While such an analysis may raise many questions, it does remain highly faithful to the elements of religious experience. However, the author asks whether this permits much noetic content for faith and whether the analysis is able to account for observed change in faith ("religious" and "theoretic" knowledge being held separate).

230 pages. \$3.00. Mic 57-2249

THE TRANSMISSION OF THE ETHICAL TRADITION IN THE SYNOPTIC GOSPELS AND THE WRITINGS OF PAUL

(Publication No. 20,039)

Nels Leroy Norquist, Ph.D.
The Hartford Seminary Foundation, 1956

Chapter I of this thesis sets forth the question of the ethical tradition in the early days of the Christian religion. From the earliest times the sayings of Jesus seem to have been ignored by many Christians, Paul included. Mark also seemed to be more interested in the preaching of the cross than in the sayings tradition. But as time went on various traditions of Jesus' sayings began to appear and were incorporated into the Gospel of Mark. The question is posed, can we find within the Synoptic Gospels and the writings of Paul the clue to the early indifference to the sayings of Jesus, and the reason for the later recognition of their value?

The procedure followed is to examine in turn the writings of Paul to discover his attitude to Jesus' sayings, and then the Synoptic sources, Mark, Q, L and M, for clues as to why the material was preserved, what attitudes were held toward Jesus, and the process by which the Gospel of Mark was combined with the sayings traditions.

In Chapter II, on Paul, it is shown how Paul knew some of the sayings of Jesus but was somewhat indifferent to them, as seen by the fact that he never made a conscious effort to collect sayings of Jesus. The reason for this is that, while he did not ignore the fact of Jesus' earthly existence, he was more interested in the death and resurrection of Christ as bringing about the new age.

Chapter III is on Mark, and here it is shown that Mark subordinates the ethical tradition to the preaching message concerning the cross. Nevertheless, Mark started the process whereby the message of the cross began to incorporate teachings of Jesus into itself. The new thing in Mark is the realization that Jesus' ministry was a manifestation of the Spirit. Mark also realizes that his words belong to the age of the Spirit.

Chapter IV is concerned with the tradition known as Q, a tradition which was collected by some one who viewed Jesus as the Wisdom of God, as the Son who spoke out of an intimate knowledge of the Father's will. Q is little concerned with the cross; its focus is the earthly life of Jesus, the one in whose ministry of teaching the new age had come into existence.

In Chapter V Luke and his special material come under observation, and it is discovered that the L material shows a Jewish background. Luke weaves L and Q into his more cosmopolitan outlook, and he places the mighty words of Jesus within the Markan framework of mighty signs.

Matthew and his special material, dealt with in Chapter VI, are of interest because of the strongly Jewish background. The M material is more pronouncedly Jewish in sympathy than even Matthew, who reveals an interest in the Gentile mission. Matthew, even more clearly than Luke, sets the teaching ministry of Jesus within the framework of his mighty deeds.

We thus have the Jewish segment of the early church to thank for the preservation of Jesus' sayings. In Mark we see the preaching message gradually assimilating sayings of Jesus into itself, while in the sayings traditions we find a recognition of the saving significance of Jesus both in word and deed. Thus, in spite of their earlier separation, the sayings tradition and the preaching message tend to draw together, and are finally combined in what we know as the Synoptic Gospels. 310 pages. \$4.00. Mic 57-2250

SOCIAL PSYCHOLOGY

STRESS, PERSONALITY, AND PERFORMANCE ON COURSE EXAMINATIONS

(Publication No. 21,155)

Neil Alan Carrier, Ph.D.
University of Michigan, 1956

Chairman: W. J. McKeachie

The problem of this study was to determine the relationship of four personality variables to performance of students on a course examination under experimentally manipulated stress.

The variables are:

1. The SA (Permeability) dimension: a measure of tendency to be influenced by internal and external stimuli and to dependence upon others in decision making.
2. The S (Stability) dimension: a stability-anxiety dimension reflecting nervous tension and desurgency.
3. Need for Achievement (n Ach): a measure of need for success in competition with some standard of excellence.
4. Need for Affiliation (n Aff): a measure of need to establish or maintain positive affective relations with others.

Subjects were students in Introductory General Psychology at the University of Michigan during the Spring semester, 1955.

A regression equation was devised to predict the scores of these students on their third examination. Independent variables in the regression equation were grade-point average, American Council on Education total test score, and scores on the first two course examinations. The weights for these independent variables were computed from data on students in the same course during the previous semester.

When the predicted third examination scores were computed, two equated groups were formed by assigning students to a low or high stress experimental group where they took their third examination. This "matching" procedure controlled for intellectual and motivational factors which influence performance.

Stress was conceived as situational conditions which a student perceives as erecting potential barriers to his movement toward the goal of doing well on the examination. A high stress group was created by certain operations calculated to raise stress to a reasonable maximum. A low stress group took the test under conditions in which attempts were made to reduce stress as much as possible. The final sample of subjects consisted of 125 students in each of the stress groups.

The data were analyzed to determine whether students who obtained certain scores on the personality measures had shown a differential performance response under the two stress conditions.

Findings:

1. The examination scores of female subjects were

more detrimentally affected by stress than those of male subjects.

2. As was predicted, the examination scores of high SA students were more detrimentally affected by stress than those of low or moderate SA students.

3. An hypothesis predicting greater detriment to the performance of low S than to that of moderate or high S students under stress received tentative support for male subjects only.

4. A prediction that moderate n Ach males would show a greater performance decrement than low or high n Ach males was not validated. However, low n Ach females were more detrimentally affected by stress than moderate or high n Ach females.

5. A prediction that high n Aff subjects would show a greater performance loss than moderate or low n Aff subjects was not verified.

6. When the virtually uncorrelated SA and S dimensions were combined to produce four personality "types," high SA-high S females displayed a significant performance decrement under stress. High SA-high S males gave similar but statistically unreliable results.

7. Similar analysis of n Ach-n Aff types showed no performance differences between stress conditions by male subjects. Examination scores of low n Ach-low n Aff females under the two stress conditions were significantly different.

Performance on course examinations is determined not only by intelligence and knowledge of materials, but also by the interaction of stress conditions and personality factors. Students most detrimentally affected by stress conditions are likely to be: highly permeable females, low stability males, low n Ach females, high permeability-high stability females, and low n Ach-low n Aff females. They are also likely to be females rather than males.

104 pages. \$2.00. Mic 57-2251

STIMULUS AMBIGUITY AS A FACTOR IN CONFORMITY

(Publication No. 21,159)

John Stenger Caylor, Ph.D.
University of Michigan, 1956

In recent years the social sciences have devoted an increasing amount of attention to the problem of social conformity. With this increase in attention has come a corresponding increase in the amount of empirical research on the problem of conformity. Despite the present large number of studies in this field, there is no general theory in terms of which the body of findings can be summarized. Such a general theory must be built on general variables which cut across the phenotypic aspects of specific studies, and general variables of this sort have not

yet been developed. This problem is not unique to the area of conformity but is a problem common to all social psychology.

Since all studies of behavior necessarily involve some stimulus operation, this thesis attempted to develop one of the many possible stimulus dimensions on which all stimulus operations might be ordered. The dimension that was developed was that of stimulus ambiguity, which is defined in terms of the variability of response to the stimulus under specified standard conditions.

On the basis of a probability model, it was hypothesized that the effectiveness of a group influence in changing the response to a stimulus in the direction of a group norm would be a function of the ambiguity of the stimulus.

This general hypothesis was tested in an experiment utilizing two verbally presented social conflict situations as stimuli. The ambiguity of each stimulus was assessed independently, and was then related to the change which was produced in the response to that stimulus by a constant group influence operation.

Behavior change was defined in terms of three separate variables, each of which in turn is a necessary but not a sufficient condition for the next. In order of demandingness these variables were: perceived discrepancy from group norm; movement or behavior change independent of group norms; and conformity, defined as movement in the direction of the perceived group norm.

Since all subjects responded to both stimuli, behavior change was compared both to interstimulus differences in ambiguity and to individual differences in the ambiguity of each stimulus. The specific hypotheses being tested were supported by these findings:

1. The two stimuli were reliably discriminated by the measure of stimulus ambiguity.
2. Perceived discrepancy from group norms was significantly related both to the ambiguity of the stimulus and to individual differences in the ambiguity of each stimulus.
3. Movement or behavior change without regard to the norm was significantly related to individual differences in the ambiguity of each stimulus. That the relationship between movement and ambiguity of the stimulus did not reach an acceptable level of significance, ($P = .11$), is attributed to the large amount of individual difference in ambiguity.
4. Conformity, defined as behavior change in the direction of the perceived group norm, was significantly related both to the ambiguity of the stimulus and to individual differences in the ambiguity of each stimulus.

It was concluded that the dimension of stimulus ambiguity offers promise as a general variable in terms of which the stimulus operations of different studies may be related, independently of their findings.

59 pages. \$2.00. Mic 57-2252

COMMITMENT TO PROFESSIONAL VALUES AS RELATED TO THE ROLE PERFORMANCE OF RESEARCH SCIENTISTS

(Publication No. 21,170)

Robert Campbell Davis, Ph.D.
University of Michigan, 1956

The point of departure for this study is the proposition that the effectiveness of an individual's role performance is dependent on the congruence of personality factors with the socially defined role expectations. Hypotheses elaborated from this general assumption are tested in an analysis of certain socio-psychological factors related to the role performance of scientists in a large organization devoted to basic medical research. The factors singled out for attention include the degree of commitment to basic science values, the degree of commitment to institutional (status-achievement) values, and the degree of influence of the role incumbent over decisions affecting his role.

The interrelationship of these factors, as related to role performance, forms the focus of the research. Effectiveness of role performance is hypothesized to be positively related to commitment to role-consonant (science) values, and negatively related to values not consonant with the role (institutional values). Commitment to both sets of values is hypothesized to be associated with less effective role performance than predominant commitment to role-consonant values. Furthermore, the degree of influence of the role incumbent is hypothesized to accentuate these relationships by permitting the role incumbent to maximize his values. In addition, it is hypothesized that the degree of commitment to values not consonant with the role is also related to a feeling of conflict or tension which is manifested in the desire to leave the role.

The relevant organizational factors (goals of the organization, the reward system, and the structure of authority) firmly support the science orientation for personnel in the research role under investigation.

The subjects for the study are 204 scientists at the doctoral level, all of whom are confronted with roughly the same role expectations as defined by the research organization. The measures of values are based on responses to a questionnaire concerning factors which are important to the scientist in his job. The influence variable likewise derives from the estimate of the scientist as to his ability to influence decisions affecting his work. The performance variable, however, is not derived from the questionnaire; it is based on independent global ratings of research effectiveness made by colleagues in the organization.

The findings of the study may be summarized as follows:

1. Individuals whose values are consonant with the role expectations perform the role more effectively than individuals whose values are not consonant with these expectations.
2. Individuals who are simultaneously committed to both sets of values perform less effectively than those who are predominantly committed to role-consonant values.
3. Individuals whose values are not consonant with the role expectations manifest the desire to leave the role.
4. The ability to influence decisions affecting the role and the degree of value commitment taken together show a more marked relationship to performance than either factor considered separately.

In short, effective role performance may be seen as a resultant of unambiguous commitment to role-consonant values and the ability to influence the environment in order to translate these values into behavior. These findings are interpreted as lending support to the proposition that effectiveness of role performance is dependent on the congruence of certain personality factors with socially defined role expectations. 104 pages. \$2.00. Mic 57-2253

A STUDY OF THE CRITICAL REQUIREMENTS OF CONFERENCE BEHAVIOR

(Publication No. 18,232)

George Leonard Gropper, Ph.D.
University of Pittsburgh, 1956

The practical interest in how conferences may be effectively conducted has brought attention to the need for the development of satisfactory procedures for evaluating conference effectiveness. To be considered satisfactory an evaluation procedure or criterion must be based on all the important elements of behavior that make for effective conferences. In addition it must make provision for those behavior elements to be observed accurately and objectively. A review of the literature reveals that evaluation procedures currently being used either fail to identify all the essential elements in conference behavior or fail to measure some of the elements they do identify with sufficient objectivity.

Systematic procedures for analyzing an activity under study have been responsible for developing satisfactory criteria in other research areas. The critical incident technique, for example, has been able to identify the essential elements of behavior in a variety of activities. The critical incident technique is a set of procedures for the collection of direct observations of incidents or acts relevant to the primary aim of an activity. Those incidents are said to be critical if, in the judgment of qualified observers, they make the difference between the success or failure of that activity. The set of categories, inductively arrived at, which summarizes the collected critical incidents constitutes the critical requirements or essential elements of the activity.

In the present study the development of criteria for the effectiveness of decision-making conferences has relied on the critical incident technique for a systematic analysis of conference behavior. Two hundred and thirty-four participants, business executives, government officials, and military officers, described a total of 1181 incidents which they judged to have made the difference between the success or failure of decision-making conferences they attended. Of this total, 547 incidents reported were descriptions of the behavior of conference leaders, and 634 incidents reported were descriptions of the behavior of other conference participants.

"Leader" and "participant" incidents were analyzed separately. For each group an inductive classification of incidents led to the formulation of major categories and subcategories. The major categories represent the essential elements or critical requirements of conference behavior. Tests bearing on the generality of these findings reveal that the critical requirements may be applied to a

variety of situations. The subcategories or critical behaviors are descriptions of behavior that are general enough to summarize a variety of behaviors economically. At the same time they are specific enough to permit an observer to classify with relative ease and accuracy actual behavior occurring in a conference.

One of the necessary features of a satisfactory criterion is its relevance. A criterion is relevant when all the factors making for success in it are the same as the factors making for success in the actual activity under study. The critical requirements and the critical behaviors subsumed under them represent a comprehensive description of factors that make the difference between the success and failure of conferences. As such they provide the raw materials for a relevant criterion.

A second necessary feature of a satisfactory criterion is the objectivity with which the observations and measurements on which it is based are made. Objectivity or inter-observer agreement depends on the simplicity of the observer task and the standardization of the conditions of observation. The critical behaviors developed in this study are stated in precise, objective terms. Evaluation of behavior consists in the simple noting and recording of instances of behavior similar to the specific descriptions made available. The specific, behavioral descriptions provide a common framework and standard for all observers. Thus, the relative simplicity of the observer's task and the comparability of conditions under which it is performed facilitate inter-observer agreement or objectivity.

It may be concluded that the critical requirements developed in this study make possible a relevant criterion that can be applied objectively.

98 pages. \$2.00. Mic 57-2254

THE RELATION OF SOCIAL CLASS IDEOLOGY TO ATTITUDES IN AN INDUSTRIAL ORGANIZATION

(Publication No. 21,181)

Gerald Gurin, Ph.D.
University of Michigan, 1956

This study investigates the relation of social class ideology to attitudes in an industrial organization. Two theoretical problems are involved. At one level, the concern is with the conceptualization of "class" as "reference group;" an attempt is made to analyze the types of individual-class relationships that would lead to the acceptance of normative prescriptions of class-representative groupings in an industrial situation. At a more general theoretical level, this analysis is placed in a broader context, looking beyond specifically class groupings to the general question of the relationship between attraction to a group and conformity to group norms. The study re-evaluates some of the traditional assumptions about the relationship between a positive orientation to a group and the readiness to accept group influence, pointing up the conditional nature of this relationship, and its dependence upon the basis as well as the strength of the attraction to the group.

The data in the study are based on the responses to questionnaires administered to the non-supervisory blue-collar workers in a unionized factory. The design of the

study is a "correlational" one, with groups differentiated in terms of their responses to the ideological questions, being compared on their attitudes to different aspects of the factory setting.

Orientations toward working-class groupings and orientations toward higher-class groups are considered separately in this investigation. Positive and negative orientations toward higher-class groupings are defined in terms of acceptance and rejection of the class system. These acceptance-rejection patterns are operationalized in terms of measures of class-conflict perceptions, on the assumption that perceptions which minimize the existence of class conflict--referred to as "class denial" beliefs--represent a positive orientation to higher-class groupings. Two general hypotheses are offered: (1) that "class denial" will be associated with the perception of company and union, and company and workers, as compatible groups in the factory; and (2) that "class denial" will be associated with positive attitudes toward "company" and "management." In general, these hypotheses are supported by the findings.

The analysis of working-class orientations focuses on a distinction between two "types" of attraction processes: "instrumental attraction" in which the class grouping is valued as a means to the satisfaction of self-oriented needs, and "intrinsic attraction," where class membership represents an end in itself, is itself a value or embodiment of values. "Intrinsic" and "instrumental" orientations toward working-class groupings are operationalized in terms of the comparable orientations toward unionism. It is hypothesized that, with the strength of attraction to the union held constant, "intrinsically" attracted union members will evidence greater conformity to the union's attitudinal and behavioral prescriptions than will those attracted to the union in "instrumental" terms. The findings with respect to this hypothesis are somewhat equivocal. Although most of the findings support the hypothesis, the expected relationships are not obtained with respect to the major union values that were measured in the questionnaire.

In general, the findings tend to support the basic assumptions of the study--that the social structures of the factory and the broader community are interdependent systems, and that reactions of individuals to these social structures generalize from one social system to the other. They also support the assumption that positive orientations to higher-class groupings manifest themselves in denial patterns. But the findings also suggest a possible reconsideration of the theoretical formulations from which the hypotheses about intrinsic-instrumental differences were derived. This reconsideration involves a distinction between "mature" and "anxiety-defensive" conformity processes, and an examination of the relationship of these two processes to the nature of attraction to the group.

347 pages. \$4.45. Mic 57-2255

THE STABILITY OF THE SELF-CONCEPT AND SELF-ESTEEM

(Publication No. 20,079)

Thomas P. McGehee, Ph.D.
Michigan State University, 1956

The present research was designed to investigate the relationship of self-esteem to stability of the self-concept. In order to carry out this aim it was necessary to study the effectiveness of various methods of measuring the variables of self-esteem and stability. As a consequence of this study it was hoped to provide a clearer delineation of what it is that is measured by these devices. As a part of this problem an effort was made to develop a measure of self-concept stability that would be functionally independent of self-esteem.

Three hypotheses were tested by the research. The first hypothesis stated that self-esteem is the primary psychological dimension measured by Brownfain's index of self-concept stability. The second hypothesis was a formulation of the relationship of self-esteem to self-concept stability. It stated that those persons who have introjected or internalized contradictory systems of valuation will have unstable self-concepts. The third hypothesis dealt with the influence of ego-defensiveness on measures of self-esteem. It was proposed that the measure of self-esteem least influenced by ego-defensiveness will be the most effective measure of self-esteem.

Measures of the stability of the self-concept, of self-esteem, of ego defensiveness, of disturbance in family relationships and sociometric measures of adequacy in interpersonal relationships were administered to 81 graduating high school seniors. Information was also obtained concerning the intellectual ability, scholastic competence and adjustment of the students and the socio-economic status of the parents of the students. The above variables were intercorrelated and the resulting matrix of intercorrelations analyzed. Prior to collecting the data predictions were made as to the direction of the relationships for each correlation obtained from the intercorrelation of all the major variables. In addition hypotheses I and III involved the making of predictions as to the relative magnitudes of the relevant correlation coefficients.

Two measures of the stability of the self-concept were developed that were completely free from contamination by the variable of self-esteem. These were the measures of temporal stability and intraparent discrepancy. The former is a measure of the amount of change in the ratings made of the actual self over time. The latter is a measure of inconsistency of parental attitudes toward the child. It is a measure of the discrepancy between the concept the student believes his mother has of him and the concept the student believes his father has of him.

The three hypotheses the research investigated appeared to be strongly supported by the results obtained. As a by-product of the study support was also found for the theoretical proposition that the stability of the self-concept is a dimension of personality closely related to feelings of self-esteem and to adjustment and interpersonal adequacy. An interpretation of self-esteem consistent with the results of the study was offered.

Because measures of self-concept stability which are based in part upon a rating of the actual or true self seem to be seriously contaminated by self-esteem, the results

of the study seemed to justify question the adequacy of the Rogerian self ideal-self discrepancy as a measure of self-concept stability.

Ego defensiveness as measured by the K scale was not a critically important variable in the study. There are hints however that there may be some form of defensive-

ness not measured by the K scale but related rather to socio-economic status which entered into certain of the measures of self-esteem. The results seem also to suggest the possibility that individual test-retest measures of reliability of paper and pencil tests of personality may be good measures of personality in their own right.

116 pages. \$2.00. Mic 57-2256

SOCIOLOGY

SOCIOLOGY, GENERAL

SOME CORRELATES OF RURAL LEADERSHIP AND SOCIAL POWER AMONG INTER-COMMUNITY LEADERS

(Publication No. 20,070)

Wade Huff Andrews, Ph.D.
Michigan State University, 1956

This study is concerned primarily with the study of inter-community county level rural leadership. More specifically the purposes are to (1) analyze formal leadership patterns at the county level; (2) to study the informal networks of social relations in the inter-community social system including interpersonal resources among the sample respondents and those named as important influentials; (3) to consider the inter-relations between formal leadership and influence by studying the configuration of formal positions and interpersonal resources that make up the power and decision making structure of rural organizations of the county.

The method used in this research included a participant observer reconnaissance followed by the use of a schedule in interviewing a random sample of county rural organizational officers. The third phase included interviewing those named as the most important influentials.

The schedule included questions covering all organization activity, patterns of acquaintance and interaction including those worked with and those they get advice from, the important action organizations, the channels through which they affect decisions in important groups, key legitimizing leaders, and patterns of interpersonal resources with influentials. These elements were analyzed both statistically and empirically by charts. Three professional leaders were included among the influentials named.

Holding offices was found to be an important characteristic of those interviewed both at the county level and in local groups. There was interlocking of authority roles in county organizations and offices were an important means for legitimizing leadership. There was a tendency for more important policy-making roles to cluster around a relatively few persons that were also top influentials.

The statistical analysis of relationships revealed that county leaders are well acquainted in general but that influentials were better acquainted and had a more extensive acquaintance pattern than other leaders, also secondary leaders tended to over rate their claims of acquaintance with top influentials.

For the access elements, getting advice from and work-

ing with leaders, there was generally a high rate of activity and no significant difference between influentials and other leaders, however, the interaction of influentials was higher between themselves than with the sample leaders. Thus, access with important decision makers was more available to top influentials.

Interpersonal resources included friendship and associational relationships, top influentials had a significantly higher average number than did the sample respondents. The networks of association between influentials are shown on sociometric charts.

The county level leaders were not limited in association by space, but some types of interaction was associated with local areas while others were not. The networks of resources furnish a potent means for spreading and gathering information, opinions and policies. These systems show an ongoing structure through which leadership can function both inside and outside of the formal organizations.

Respondents named their channels of influence and key leaders largely from among the top influentials, however, this varied for some groups. Choices of non influentials seemed to indicate less efficiency in affecting decisions.

Through offices and informal resources leaders were able to affect decisions both directly and indirectly. Since offices and resources were related a knowledge of the organized social structure would give a leader important insight into the decision making structure and process in the county. Several case studies illustrate the function of influential power, particularly in regard to the role of the professional leader. 308 pages. \$3.95. Mic 57-2257

PATTERNS OF INFORMATION EXPOSURE AMONG WORKERS IN A RURAL TOWN COMMUNITY IN SOUTHERN BRAZIL

(Publication No. 21,048)

Thomas Lucien Blair, Ph.D.
Michigan State University, 1956

In Brazil, the development of industrial enterprises based on the milling of agricultural cash crops placed large numbers of people into close proximity and manifold social relations. The process of industrialization created a wider range of communication and social interaction which facilitated the diffusion of information. Workers in rural town agro-industrial communities became increasingly exposed to new ideas, opinions, and news.

The author explored the variations in information exposure among three occupational groups, agricultural, factory, and office workers, in the agro-industrial structure of a rural town community in southern Brazil. Three sources of information exposure were investigated: (a) selected mass media, (b) social visiting, and (c) contact with outside persons. Answers were sought to several questions: How are workers exposed to new information? What are the patterns of exposure? What are the differences in the exposure of workers to various channels of information?

Tests of thirteen operational hypotheses indicated that agricultural workers were less exposed to information than factory workers who, in turn, were less exposed to information than office workers. It was noted that:

Agricultural workers did not possess the necessary prerequisites (e.g., literacy and income) for the use of media. They were infrequently exposed to new information through social visiting and had infrequent contacts with bearers of information from the outside world.

Some factory workers possessed the prerequisites for use of media. Among those who were exposed most had access to newspapers and radios. Their information exposure was re-inforced and expanded by frequent visiting with other exposed workers and by frequent contact with outside persons. Cross-occupational visiting by factory workers facilitated the dissemination of information up and down the occupational scale.

Office workers were literate and had substantial incomes. They were frequently exposed to media. Their frequent exposure was expanded through visiting with highly exposed fellow workers and by wide contacts with outside persons.

The study revealed three specific types of audiences on the basis of exposure to new information:

Type A.

1. Primacy of inter-personal information exposure.
2. Exposure to new information infrequent.
3. Content of information received: local and provincial.
4. Persons typically rural illiterate agricultural workers.
5. Oriented toward traditional "folk" values and patterns.

Type B.

1. Primacy of oral and direct exposure to mass media; oral exposure supportive of direct exposure.
2. Exposure to new information more frequent than Type A.
3. Content of information received: often about non-local occurrences.
4. Persons typically urban semi-literate factory workers.
5. Transitional between traditional folk values and those of modern society.

Type C.

1. Primacy of direct exposure to mass media.
2. Exposure to new information a daily occurrence.
3. Content of information received: urbane and cosmopolitan.
4. Persons typically urban literate office workers.
5. Oriented toward modern values common in large Brazilian cities.

In sum, the socio-economic organization of the rural town agro-industrial community in Brazil exposes varying groups of workers to different social environments which in turn affect the probability that they will possess a given pattern of exposure to new social knowledge. Analysis showed that the observed patterns of exposure to information through mass media, social visiting, and contact with persons from outside were significantly related to occupational position, location of work, and position in the family life cycle. 223 pages. \$2.90. Mic 57-2258

THE ATTITUDE EFFECTS OF EDUCATIONAL DESEGREGATION IN A SOUTHERN COMMUNITY: A METHODOLOGICAL STUDY IN SCALE ANALYSIS

(Publication No. 20,489)

Ernest Queener Campbell, Ph.D.
Vanderbilt University, 1956

Supervisor: Professor Albert J. Reiss, Jr.

The most impressive recent development in the area of attitude measurement is the Guttman scaling technique. It is the purpose of this study to explore the utility of Guttman scale analysis in the measurement of change in attitudes. The principal focus of the study is therefore methodological.

The study model is that of the natural experiment with before-after measurements. Questionnaires were administered to three junior and senior high school grade levels in a Southern community operated by the federal government. The Before measurement was taken in April of 1955, prior to desegregation in September. The After measurement was taken in February of 1956. Replies were anonymous, but Before-After forms were matched for 746 students on the basis of personal data.

Four scales that satisfied all Guttman scale criteria were constructed with Before data. They were entitled: Negroes in School Situations scale; School Desegregation scale; Rights of Negroes scale; and Characteristics of Negroes scale. The items continue to meet scale criteria on the After measure. This suggests that a unidimensional order continues to exist in a content universe on a second measurement separated from the first by experiences among respondents of presumed relevance to the attitude universes.

Scale scores are the basis for classifying respondents as Non Changers or Changers, and by direction of change. Error types complicate this procedure, especially those error types that cannot be assigned a scale score by the

principle of least error. The utility of Guttman scale analysis in attitude change studies is impaired by cases of arbitrary score assignment. It is recommended that the number of error types may be reduced by (1) limiting the number of scale items to perhaps four or five; (2) maximizing the spread in difficulty among items when scale items are selected from Before data; (3) careful pre-testing for ambiguities in possible scale items.

Use of a uniform point for dichotomizing items is recommended in attitude change studies. This in turn requires an even number of item response categories, lest the observed direction of dominant attitude change be a spurious consequence of a greater number of possible responses showing change in one direction than in the other.

Intensity analysis is attempted as a means of dividing respondents into those favorable and those unfavorable. Crossing the zero point may then be the criterion of attitude change. A zero point is established for only one scale, since the fold-over technique is inappropriate when there is an odd number of response categories and a uniform item dichotomization point. The findings suggest the following desiderata for the use of the zero point in attitude change studies: (1) an even number of item response categories; (2) an even number of scale items; (3) a centrally located zero point; and (4) invariance of the zero point in the Before and After measurements. The zero point is invariant on the one scale for which it is established in this study.

Additional measurement issues that are discussed include the regression effect, the sampling of items of specific levels of difficulty, the effects of times of measurement on results, and the problem of loss of cases.

Tests of substantive hypotheses give the following results: (1) Neither cross-pressures nor authoritarian score are related to attitude stability; (2) Previous equal-status interaction with Negroes is predictive of attitude stability; (3) Attitude change is more frequent when the perceived position of significant others differs from the position taken by the subject, and the movement of attitude change is toward greater affinity with the perceived positions of these others; (4) Present friendship with Negroes is associated with positive attitude change, but number of classes with Negroes is not; (5) Change in scale position on any given scale is to a considerable extent accompanied by change in the same direction on any other scale; (6) There are more persons classified as Negative Changers than as Positive Changers on all scales, and the means of the distributions of scale scores are significantly lower on the After measure on all scales.

There are two qualifications of the last finding: (1) The results may be a function of the times of measurement; (2) Intensity analysis on the School Situations scale shows (a) more positive than negative change across the zero point; (b) more positive than negative change from the zero point; (c) more negative than positive change among those who remain on either side of the zero point.

474 pages. \$6.05. Mic 57-2259

THE JAPANESE AMERICAN RENUNCIANTS OF
OKAYAMA PREFECTURE: THEIR ACCOMMODATION
AND ASSIMILATION TO JAPANESE CULTURE
(VOLUMES I AND II)

(Publication No. 21,138)

Gladys Ishida, Ph.D.
University of Michigan, 1956

The purpose of this study is to describe and interpret the behavior and adjustment of the Japanese American renunciants of Okayama Prefecture to Japanese culture. These persons of Japanese ancestry are those who renounced their citizenship while still in the United States and then went to live in post-war Japan. The importance of this analysis arises from the fact that a) no study of the renunciants who sought their future in Japan has yet been done, and b) the adjustment of these renunciants in Japan offers some insight into the processes of acculturation.

In the beginning of the study, the highlights of Japanese immigration in America, of the nature of the Japanese community in America, of the critical events of the war-time policy of evacuation and detention of Japanese are presented as background material in order to bring into focus the effect they have had on the motivations of this group. Intensive interviewing was the chief method of gathering data on the renunciants. Oral interviews of each of the twenty-seven renunciants were guided by a detailed outline, in order to help them refresh their memories, since the range of information desired was extensive, ranging as it did from their childhood and family to their activities in Japan since their return. These interviews were generally conducted at their places of residence and business in order to observe their work-a-day world and to gain additional insight to their behavior. Supplemental data of the life histories were obtained from the parents of the renunciants whenever they were available; this was a checking device on the renunciant's memory and details which the renunciant himself could not remember. As a result, data on oral, life history interviews and observation of behavior provided the basis of empirical research.

Significant differences in the adjustment of the two categories of renunciants--the Kibei and the Nisei--to Japan are explained in terms of their divergent cultural backgrounds in training and education and their present motivations. Since the Kibei renunciants had been taken to Japan during their early childhood, reared and educated there, they were equipped with the proper cultural tools to make an easy re-adjustment to Japanese life. After almost a decade of residence in Japan, the Kibei no longer have any lingering thoughts of returning to America. The behavior of the Kibei indicates a harmonious integration with the Japanese cultural pattern to the extent that even their Japanese neighbors take them for granted. On the other hand, the Nisei renunciants had their basic education and training in America and few of them had ever visited Japan. They were, therefore, oriented more to American culture than Japanese, with the exception of certain Japanese values and virtues transmitted to them by their parents. They were not equipped with the proper cultural tools to live in Japan. After nearly a decade of post-war residence in Japan, these Nisei renunciants still continue to look forward to the day they can return to America; they consider their stay in Japan as temporary. Yet, living

in Japan, even for an interim period, necessitated certain accommodations to the Japanese cultural pattern.

The study of adjustment of individuals reared in one cultural milieu and transferred to another offers highly favorable conditions for research into the nature and processes of culture. Hence, the divergent patterns of adjustment of the Japanese American renunciants reflect an attachment to the particular sources of the values of a culture bred in individuals during childhood and a striving for the realization of these values in accordance to the basic needs of the individuals.

339 pages. \$4.35. Mic 57-2260

**THE CITY AND COMMUNAL LIFE:
A RE-EXAMINATION OF URBAN SOCIOLOGICAL
THEORY**

(Publication No. 21,044)

Elwin Humphreys Powell, Ph.D.
Tulane University, 1956

Chairman: William L. Kolb

For analytical purposes the city can be conceived as a system composed of three elements: (1) an existential base, (2) an institutional matrix, and (3) an ethos or value system which permeates the whole structure. Conceived as a whole, the city has an emergent social character which is the product of the interaction of these three components. Urban sociology usually considers the existential order as the independent variable, determining the social character of the city. The present study advances an evaluative hypothesis, suggesting that the social character of the city is the product of a value system operating within the context of urbanization.

The social character of the modern city is distinguished by two features: the absence of communal solidarity, and the presence of a functional cohesiveness. The city is integrated but without community. Not only has the city as a whole ceased to be a community, but groupings within the city--kinship, neighborhood, church, guild--have lost their solidarity. Functions once discharged by communal groupings are now carried out by associations. In an associational society, since ordinarily no single group fully envelopes the person, there is a great deal of individualism and rationalism. Consequently, the modern city appears to be little more than a population aggregate, a society of strangers.

This breakdown of community, according to the existential hypothesis, is mainly the result of demographic factors. Population density intensifies competition, gives rise to heterogeneity and mobility, creates an anonymous and segmented environment, and shatters the unity of belief and outlook which is supposedly typical of non-urban cultures. The person is individuated, and the society secularized. Competition and the "struggle for existence," which are assumed to be biotic or sub-social processes, provide a minimum of social order but little consciousness of solidarity. The population of the modern city, it is argued, is too large and diverse to be embraced by a single value system, and consensus breaks down.

According to the evaluative hypothesis, on the other

hand, it is the presence of a particular kind of consensus which leads to the decline of communal solidarity and brings about the functional integration of the city. It is suggested that the breakdown of community occurred prior to the emergence of the large industrial city. Capitalistic society is by its nature non-communal, and capitalism is the expression of a value system. The market economy was created by consensus. The social character and the ecological configuration of the modern city are largely the products of capitalism, not urbanism.

While the social character of the modern city can be deduced from either the existential or evaluative hypothesis the final test of the two theories comes through a study of pre-modern cities. The medieval city, despite the fact that it was relatively large and heterogeneous, retained a communal character. There was little individuation in the medieval city, and the city was founded on a sacred value system. Economic life was regulated by the community. It is impossible to understand urban life in the Middle Ages without taking cognizance of the value system of medieval culture. The religious, not the economic, institution was the nucleus of the city.

Thus, it appears that the existential hypothesis, which is the unstated premise of contemporary urban sociology, is culturally limited. While the terms of the evaluative hypothesis have not been clearly formulated, the present study suggests the need for a theory that can deal with the value component in urban life.

428 pages. \$5.45. Mic 57-2261

**ECONOMIC DOMINANCE AND PUBLIC LEADERSHIP:
A STUDY OF THE STRUCTURE AND PROCESS OF
POWER IN AN URBAN COMMUNITY**

(Publication No. 21,359)

Robert Oscar Schulze, Ph.D.
University of Michigan, 1956

This study is a descriptive analysis of the historical development and contemporary operation of the power structure of an American urban community. The structure was conceptualized in terms of two types of community power roles: economic dominants and public leaders. The former were defined as those individuals who occupied the top formal positions in the major industrial and financial units in the community; the latter were defined as those individuals who were reputationally perceived (by the heads of the local voluntary associations) as the most influential leaders in the public life of the community. The study thus attempted to view community power in terms of both objective (economic) and subjective (reputational) criteria.

Cibola, the subject community, is a satellite city of 20,000 inhabitants, located just beyond the metropolitan area of a large Midwestern industrial community.

Three major hypotheses were tested. The bifurcation hypothesis suggested that when the community was relatively little involved in the larger societal complex, the persons who occupied the economic dominant roles tended also to act as public leaders - that is, to assume active roles in the political and civic life of the community; with widening involvement of the community's economic system in that of the larger society, it was suggested that the

economic dominants' participation in and direction of the local political system diminished, these functions being increasingly assumed by a different set of persons, the public leaders. The differentiation hypothesis suggested that significant differences obtained between the current economic dominants and public leaders in terms of their general characteristics, local political and voluntary associational activities, informal relationships, and community orientations. The relative autonomy hypothesis suggested that the public leaders were relatively independent of the economic dominants in the direction of the community's socio-political life.

The bifurcation hypothesis was tested through the historical reconstruction of economic dominants from the year of Cibola's founding, 1823, until 1954. A wide variety of documentary sources was used, including local histories, tax records, and city directories. Field interviews with the public leaders and economic dominants provided the basic data for testing the differentiation hypothesis. The relative autonomy hypothesis was approached through the reconstruction of power processes involved in three recent episodes of major importance to the community's viability: the local efforts to change the form of municipal government, expand the city limits, and adjust to the impact of a huge absentee-owned industry. Field interviews again supplied the principal data.

In general, the research evidence supported the three hypotheses. As operationally-defined, there were currently 17 economic dominants and 18 public leaders, with only two individuals occupying both roles. The historical reconstructions indicated a marked withdrawal of economic dominants from participation in the community's socio-political life: prior to 1900, over four-fifths of the dominants had held local public office; since 1900, the proportion declined to one-fourth; none of the more recent dominants - those representing large absentee-owned firms - had held public office. A similar withdrawal from involvement in the community's voluntary associational life was noted.

In terms of political, associational and informal involvements, the public leaders were revealed as a highly cohesive group with pervasive local commitments, while the economic dominants - particularly those from the absentee-owned corporations - were minimally involved in the community. All segments interviewed, however, perceived essentially the same persons (the public leaders) as the most influential local leaders.

Detailed review of the recent community episodes suggested that the public leaders both initiated and directed action in Cibola's socio-political arena, with the economic dominants exercising potential veto power. Ultimately, however, the widening social and psychological distance separating the public leaders and the large corporation dominants threatened to stultify effective community action.

407 pages. \$5.20. Mic 57-2262

A CONFIGURATIONAL APPROACH TO SOCIAL PREDICTION

(Publication No. 21,462)

Robert Paton Stuckert, Ph.D.
The Ohio State University, 1956

Social prediction involves the construction of simple mathematical models according to probability theory. One problem in prediction research is to ascertain the extent to which the mathematical properties of the model match the characteristics of empirical data.

The research was based on two premises. First, the mathematical models currently used in predicting human behavior may be inadequate representations of sociological data. Second, it may be possible to develop a prediction model with properties more nearly matching the characteristics of sociological data.

The approach most frequently used in the past has been prediction by measurement. There is evidence to indicate that the use of this approach results in prediction error. This may be due to certain assumptions regarding human attributes and behavior implied in its use: (1) the samples used are drawn from homogeneous populations, (2) every member of the population is characterized to some degree by every factor or attribute, (3) social factors do not interact, and (4) social factors are quantitative or amenable to being quantified.

The primary objective of the study was to formulate a prediction method avoiding these assumptions. The method of predictive configurations as developed in this research is a variation of the prediction-by-classification approach. It is designed to predict a criterion having discrete categories according to the principle of maximum probability. Its methodology is based on the identification of small, mutually exclusive configurations of factors having predictive power.

Operational procedure is relatively simple since no complex statistical computations are required. Each sample is divided into relatively homogeneous subsamples according to factors related to the event in question. The factors are selected in such a way that the probability that a given outcome will occur exceeds an arbitrary value in each subsample. This increases the likelihood that each individual in a subsample has an equal chance of achieving the given outcome. Each subsample is defined by a unique configuration of predictors. Each predictive configuration includes the fewest predictors needed to exceed this arbitrary value.

To test the relative effectiveness of the method of predictive configurations, four instruments for predicting academic success were constructed. Three samples of freshmen entering the College of Commerce and Administration, The Ohio State University, in 1948, 1949, and 1950 were used. Predictions resulting from the use of these instruments were compared with those obtained from instruments based on three widely used prediction-by-measurement methods: the multiple linear regression, Burgess unit-weighting, and Glueck methods.

Statistical analysis of the data supported several conclusions.

1. It was possible to construct predictive configuration instruments if the criterion contained either two or three categories.

2. Predictive configuration instruments tended to be

more accurate and efficient than instruments based on prediction-by-measurement methods.

3. Predictive configuration instruments were superior to prediction-by-measurement instruments in their ability to discriminate among the individual categories of the criterion.

4. Only multiple regression instruments were more stable than predictive configuration instruments. The ability of the latter type to predict as efficiently in subsequent samples as in the initial sample was inversely related to the number and discreteness of the criterion categories.

122 pages. \$2.00. Mic 57-2263

A QUANTITATIVE ANALYSIS OF REGIONALISM IN THE UNITED STATES, 1940

(Publication No. 21,366)

David Wright Varley, Ph.D.
University of Michigan, 1956

This study of regionalism in the United States is addressed to two main questions. First, to what extent may regionalism be regarded as an independent or "explanatory" variable for human behavior? Second, to what extent may this independent character of regionalism be attributed to structural and socio-economic features of regional society? These questions are derived from the work of regional scholars whose research has produced a large body of material describing regional differences appearing in the United States.

Unfortunately, most of this descriptive material takes the form of only summary measures for the several regions. The question of how representative these summary measures are of entire regional areas is usually not answered explicitly. This is particularly unfortunate because the essence of the concept "region" involves homogeneity within territorial areas as well as heterogeneity among these areas. The research undertaken in this study treats both these aspects of the regional concept.

The study focuses on data gathered for the year 1940. The regional delineation selected for investigation is that proposed by the late Professor Howard W. Odum. This classifies the country into six regions, each of which consists of four or more entire states. The basic unit of measurement is the State economic area. These areas are groups of counties, so that in effect each region represents a population of State economic areas.

The dependent variables of this study are five types of behavior: viz., fertility, educational achievement, religious affiliation, and two indexes of political voting behavior. Measures of these types of behavior are tabulated for each State economic area. In addition, each State economic area is classified by thirteen separate structural and socio-economic characteristics. These characteristics are used in the study as independent control variables and include such items as metropolitan status, rural farm standard of living, proportion of employed workers engaged in agriculture, and per capita dollar retail sales.

The statistical measure employed in the analysis is the intraclass correlation (ρ). This analysis of variance technique indicates what proportion of the total variance of each type of behavior examined can be attributed to the

regional locations of that behavior. The procedure is as follows: (a) Intraclass correlations are computed for each dependent variable and for the total number of State economic areas in all regions. (b) Control is then exercised by selecting from within each region those State economic areas exhibiting some specified characteristic or group of characteristics. (c) Intraclass correlations are recomputed for these selected control groups. It is expected that the correlations computed for the control groups will be smaller than those computed for the total group of State economic areas. The extent to which this reduction in correlation value does occur under controlled conditions is interpreted as a measure of the extent to which regional behavior differences can be attributed to regional differences in social structure and socio-economic characteristics.

The general findings can be summarized briefly. The Odum regions are most distinctive with respect to the political behavior variables, but have negligible significance for fertility. None of the variables studied shows each region exhibiting a unique behavior pattern. Rather, regional distinctiveness in behavior appears to rest on the "deviant" position of only one or two regions while the other regions are little differentiated from one another. Generally speaking, controls for structural and socio-economic characteristics do effect a leveling of regional differences in behavior. This is particularly evident in the more urban or metropolitan areas. This suggests that as our society becomes more urbanized and industrialized regional behavior differences will either disappear or else be exhibited only as features of a regional division of labor.

257 pages. \$3.35. Mic 57-2264

THE IMPLICATIONS OF SOCIAL CLASS FOR CLOTHING BEHAVIOR: THE ACQUISITION AND USE OF APPAREL FOR GIRLS SEVEN, EIGHT, AND NINE YEARS OF AGE IN THREE SOCIAL CLASSES IN DES MOINES, IOWA

(Publication No. 20,089)

Margaret Cynthia Warning, Ph.D.
Michigan State University, 1956

The purpose of the study was to determine whether practices in the acquisition, use and care of garments for girls seven through nine years of age in Des Moines, Iowa whose families were in the upper-middle, lower-middle or upper-lower social class varied with social class. Using school census cards a sample of 212 cases was drawn from families which were: unbroken, white and had a daughter of seven, eight or nine years of age living in the home and at least one other child. The daughter attended public school in an area not known to contain a large ethnic group. The Warner Index of Status Characteristics was used to determine the social class position of the families. Data concerning the acquisition, use and care of the girls' clothing was obtained by personal interviews with the mothers.

It was hypothesized that the practices of upper-middle and upper-lower social class members would differ in regard to numbers, prices and varieties of garments

provided, in purchasing practices, in participation allowed the daughters, in the concern for the opinions of others concerning how the girls were dressed, in the construction, care, use and discarding of girls' garments and that the ways of the lower-middle class members lie between the extremely different practices of the other two social classes. Of the 92 relationships considered, 22 were in the direction hypothesized and 31 relationships were statistically significant.

In assembling girls' wardrobes the social classes varied in number of garments owned, prices paid, and the provision of different kinds of garments for occasions such as parties, church, club meetings and athletic activities. In acquiring the garments the families followed different purchasing practices, for example, they purchased in different kinds of stores, held different opinions about the importance of price and brands, toward a sizing label and toward high-style garments. The daughters in the different social classes varied in the amount and type of participation in the selection of their own clothing and the age at which they began to take part in the selection and care of garments and to sew. The amount of and reasons for construction differed. The practices in discarding girls' garments also differed. The amount of concern felt by the mothers and daughters regarding the opinions of others about the ways in which the girls were dressed differed in the various classes.

In nine of the thirty one relationships which were significantly different, the lower-middle class members behaved in a way which appeared to lie distinctly between the upper-middle and upper-lower class ways, in ten they were more like the upper-middle class members and in five more like the upper-lower class and in seven they seemed to follow a pattern of their own which was not between or like that of the other two social classes. In general the similarity of practices in the acquisition and use of apparel for girls seven, eight and nine years of age within one social class and the differences between the clothing behavior of members of the upper-middle, lower-middle and upper-lower social classes clearly revealed that the clothing behavior of families in regard to the garments of daughters varied with the family's social class.

182 pages. \$2.40. Mic 57-2265

SOCIOLOGY, FAMILY

THE RELATION BETWEEN THE USE OF AGENCY SERVICES BY DISPLACED PERSONS AND THEIR SUBSEQUENT SOCIAL ADJUSTMENT: A STUDY OF 182 CASES IN A MIDDLE-SIZED URBAN COMMUNITY

(Publication No. 21,111)

David Crystal, D.S.W.
Columbia University, 1957

This study includes all those Displaced Persons of the Jewish faith who were resettled in a middle-sized urban community under the sponsorship of a Jewish Family Service Agency. The period spans the years 1946 to 1955.

Two basic assumptions underlie the three hypotheses which the study seeks to test. They are:

(1) That an individual who is transplanted by force of circumstances from a familiar to an unfamiliar setting will react with feelings of discomfort, tension and anxiety, and

(2) That it is possible to assess the normality of response in specifically defined situations. The hypotheses deriving from both of these assumptions are as follows:

1. That those Displaced Persons who demonstrate appropriate affect - (situational hostility) - at Intake as they use the four specific social services, will tend to be the same persons who require a minimum period of economic dependency upon the agency.

2. That as defensive affect (hostility) appears more marked than the situation warrants, there is correspondingly a longer period of dependency upon the agency and that the determination of the extent of hostility at Intake is predictive of duration of economic dependency.

3. That Displaced Persons who terminate their dependency upon the agency without having resolved their negative feelings toward the agency will tend to be the same persons who fail to attain integration and adjustment in the three areas of job, income, and social adjustment.

The study utilizes three independent judges who score cases as to degree of defensiveness manifested by clients at two points in time in relation to specific services - Intake and Closing. Reliability of judgment is established through comparison of each judge's rating. These results tend to confirm two of three hypotheses relating to economic dependency.

The third hypothesis is tested through a random sample of one-half of total caseload of Displaced Persons. Follow-Up interviews with this group, now independent of agency support and guidance, tend to support, although not conclusively, the hypothesis which asserts that those who do not resolve negative feelings toward the agency tend to be the same who fail in specified areas of social adjustment.

255 pages. \$3.30. Mic 57-2266

SOCIOLOGY, PUBLIC WELFARE

THE DEVELOPMENT OF WAYNE COUNTY GENERAL HOSPITAL FROM A CUSTODIAL TO A REHABILITATIVE INSTITUTION

(Publication No. 21,188)

James Michael Joyce, Ph.D.
University of Michigan, 1956

In this study of factors related to the development of Wayne County General Hospital, an attempt is made to answer questions about significant changes in the institution in the past century. The hospital began as a poor house in which the inmates suffered extreme deprivation. The influence of the great reformer, Dorothea Dix, in 1860 brought about better physical care. In 1880 further improvement in custodial care occurred when a physician was employed as superintendent. From the turn of the

century improvement in the custodial care of the patients continued and, subsequent to 1920, an interest in treatment of a somatic type is to be noted.

With the appointment of Dr. Thomas Gruber as superintendent in 1930 further evidence of a developing therapeutic program is seen. Under his guidance a director of research was appointed, a post-hospitalization service was established, the treatment facilities were expanded, a family care program was initiated, an out-patient unit was opened, and the influence of dynamic psychiatry was felt within the institution.

Through a comparison of the earlier and present purposes and facilities of the institution, it is clear that the Wayne County General Hospital changed during the course of a century from an agency devoted exclusively to the care of the aged-poor, the one which provides adequate physical treatment, and finally to an institution which emphasizes rehabilitation through the utilization of modern psychiatric procedures. In a point-by-point comparison with standards recommended by the American Psychiatric Association, the hospital is found to meet or to surpass the standards in most instances.

Although the preponderance of the evidence supports the hypothesis that definite changes in the direction of rehabilitation have occurred at the institution, some evidence exists to the effect that in such areas as research, public relations, and volunteer programs, the shift is not great enough to meet acceptable standards.

It is, then, established that due to the combination of such factors as medical and psychiatric discoveries, greater public interest, sensational newspaper accounts, and the devotion of important hospital leaders, changes in the direction of professionally approved practices and programs have taken place. Although custodial residues still exist at the institution, the current approach is clearly one marked by concern for the rehabilitation of the patient.

120 pages. \$2.00. Mic 57-2267

SOCIOLOGY, RACE QUESTION

ATTITUDES OF OHIO PUBLIC SCHOOL TEACHERS TOWARD RACIAL INTEGRATION

(Publication No. 21,481)

Thomas Hoskins Kettig, Ph.D.
The Ohio State University, 1957

The research explored the attitudes of Ohio public school teachers toward racial integration. The study was financed by and conducted under the auspices of the School Community Development Study at the Ohio State University.

The study was based on the replies of 332 public school teachers to a self-administered schedule in twelve schools in Cincinnati, Columbus, and Cleveland. Four schools, two elementary and two secondary, were studied in each city.

The schedule consisted of three parts. Each part was designed for a specific purpose related to the central theme of the study. The first part of the schedule consisted of a series of fourteen true-false questions testing the respondents' factual knowledge of Negroes in United States history. The second part was a Likert-type attitude scale, consisting of thirty statements measuring the respondents' reactions to problem situations likely to arise in the process of racial integration in the schools. The third part was the shortened "F" scale taken from Adorno's study, *The Authoritarian Personality*. This scale was included to establish the relationship between authoritarianism and willingness to accept racial integration.

Ten hypotheses relating personal and sociological characteristics of the respondents to their willingness to accept integration guided the construction of the schedule. The nature of these hypotheses is indicated by the following findings:

1. Faculties of schools in cities where integration had been more widely practiced were more willing to accept integration than the faculties of schools in cities where integration had not been so widely accepted.
2. Female teachers, as a group, were less willing to practice integration than male teachers.
3. There was no significant difference between teachers who taught different subjects.
4. Among the white teachers, no difference was found between elementary and secondary teachers' attitudes toward integration.
5. Teachers who were the best informed about the facts of Negro history had the most liberal attitudes toward integration.
6. Younger teachers were more willing to accept integration than older teachers.
7. Teachers who expressed a preference for the Democratic as opposed to the Republican party, were more willing to accept integration.
8. Teachers who had had past experience with racial groups other than their own were more willing to accept integration.
9. The subjects who scored high on the "F" scale, the authoritarian scale, scored low on the Integration scale, indicating that those who were authoritarian do not favor integration.
10. Integration scale scores of the Negro teachers were higher than those of the white teachers, indicating greater acceptance of integration by Negro teachers.

The findings of the research together with results of other studies bearing on this problem suggest that a consistent policy, careful selection of personnel, and an understanding of community values are crucial in the success of an integration program. 107 pages. \$2.00. Mic 57-2268

S P E E C H

SPEECH, THEATER

A COMPARATIVE STUDY OF PROMPT COPIES OF "HAMLET" USED BY GARRICK, BOOTH, AND IRVING (VOLUMES I AND II)

(Publication No. 21,144)

Martha Ryan Beck, Ph.D.
University of Michigan, 1956

The purpose of this dissertation is to record and interpret, from Hamlet prompt copies used by Garrick, Booth and Irving, and from critical and scholarly sources, exactly the acting texts, interpretations of the play, emphases of meaning, production plans, and theatre effects these actors achieved.

A biographical essay on each actor deals with the factors in his experience that influenced his Hamlet. His development in the role is traced. Identification and discussion of the prompt books is given at the close of each essay.

A comparative presentation of the prompt books is made by superimposing their substance upon three copies of a basic edition of Hamlet whose pages appear side by side in three columns. Blank columns continuing below the text pages are used for material from the prompt books too extensive for inclusion on the printed pages. On the first column of printed text are Garrick's line cuts, stage directions, and words written in by Garrick. The famous "mutilation" ending written in ink in the prompt book is given on separate pages at the place corresponding to its appearance in the prompt book, a 1747 acting edition, possibly containing Garrick's early and late cuttings of Hamlet. The Garrick prompt book is owned by the Folger Library in Washington, D. C.

The second column of text is devoted to Booth. There the facts furnished in the Harvard-owned prompt book of the "1890" production are imposed. Drawings and extensive stage plans are in the column below the text. Booth's personal meditations on the play, found in his own handwriting in the Players Club copy, are placed below the text carrying the Garrick material.

Upon the third column of text is placed the information contained in a very fine production prompt book of Irving's 1878 Hamlet. The book contains the signature of I.H. Allen, Irving's stage manager. This prompt book is owned by the Houghton Library at Harvard. Preceding the text presentation, photographs of the title pages of three of the prompt books are inserted. Although the text presentation is integrally the second section in the plan of the dissertation, it is bound separately, as Volume II, in order to permit the reader to refer to the text while he reads the rest of the dissertation.

The third part of the study is an analysis, scene by scene, of the Hamlets of the three actors, as revealed in the prompt books, and as amplified by material gained from critics of acting, scholars, and illuminated in some instances by comparisons with other actors. There is a

summary of the analysis, and finally, a conclusion to the entire dissertation. Appendices include pertinent source materials. Twenty-five photographs, of actors, playbills, productions, pages of the prompt books are in Volume I.

Garrick acted Hamlet in the tradition of Betterton, although he did not use Betterton's cutting of the play. Like Betterton, he was an active, purposeful Hamlet. Garrick's chief relationship as Hamlet was to the Ghost. Garrick's Ghost scenes were vivid. In his famous "mutilation" he cut the Fifth Act and substituted for it a brief ending of his own quite different from Shakespeare's.

Booth stressed the soliloquies. The closest personal relationship for his Hamlet was with Horatio. He emphasized the "antic disposition" and the tragic fate of Hamlet. He was equipped to give such an interpretation convincingly because of his own naturally sad temperament that had been intensified by tragic fate in his personal life.

Irving was an imaginative, intellectual Hamlet who compensated for his poor voice, unimpressive figure, and shuffling gait by clever pointings of ideas, carefully wrought long pauses, magnificent and carefully appointed scenery, and a loved Ophelia whom he appropriately co-starred in his Victorian Hamlet.

729 pages. \$9.25. Mic 57-2269

A HISTORY OF RADIO BROADCASTING AT MICHIGAN STATE COLLEGE, FROM AUGUST, 1922 TO JANUARY, 1954

(Publication No. 21,168)

Marilyn Mayer Culpepper, Ph.D.
University of Michigan, 1956

The purpose of this study is to record and to analyze the development of the Michigan State College radio stations, WKAR and WKAR-FM, stations that have been pioneers in certain areas of educational broadcasting. It is hoped that the study can function as a reference for other colleges and universities contemplating educational broadcasting. In addition, the chapters on programming contain ideas and experience in various types of programs which could supply suggestions for the development of new series for radio (and television) programs. The material for this dissertation was obtained primarily from interviews with the director of WKAR, from his annual reports, and from a study of pertinent references in the college publications.

In the first part of the study a survey of the history of educational stations is presented. General note is made of the role of station WKAR in this development. Following a brief overview of the station's history, the material is specifically analyzed under the following topics: (1) administrative and technical development; (2) service programming; (3) formal instructional programs; (4) entertainment programming; and (5) public relations programming and activities.

Within the administrative and technical section, station policy, staff, and technical changes are discussed. Agricultural and home economics programming, two important areas for WKAR, are taken up in the service programming chapter. WKAR's "College of the Air" programs, presented during the 1930's, are reported in the next chapter. This section also discusses the in-school listening series. The chapter on entertainment programming concerns sports, music, and drama programming. College promotion, programming for prospective freshmen, programming by the state and federal government and state organizations are covered in the following chapter. A study of WKAR's station promotional activities and its audience concludes this chapter.

From this study it can be concluded: (1) Since 1934, the station's director has largely been responsible for the station's growth and activities. (2) WKAR's programming, designed for adult audiences, has consisted primarily of broadcasts in the fields of agriculture and home economics, classical music, and sports. The policy has been not to compete with commercial stations, but rather to program for special groups of listeners. (3) Although WKAR underwent a period of interest in formal instructional programming, the station's educational programs since 1938 have shown a trend toward informal instruction. (4) WKAR's programs, with few exceptions, have been practical and pertinent to the problems of the times. The titles, information presented, and types of programs themselves obviously have been developed with an eye to practicality. Often they have even anticipated problems and situations. (5) In recent years the stations have shown a trend in the direction of increased use of recorded programs. (6) The development of the WKAR Tape Program Service has extended the station's coverage. The tapes are being used by both commercial and educational stations as supplementary public service material. (7) Since no audience research has ever been completed in connection with WKAR, there is little evidence to indicate the success of any of the programs. (8) WKAR has served as a valuable means of promotion for Michigan State College. The broadcasting and publicizing of college news, activities, and events have been continuous. It has helped create greater interest in the college.

162 pages. \$2.15. Mic 57-2270

THE EDUCATIONAL TELEVISION STATION IN HIGHER EDUCATION

(Publication No. 21,490)

Hubert Pershing Morehead, Ph.D.
The Ohio State University, 1957

In 1952 the Federal Communications Commission allocated approximately 10 per cent of the television spectrum for non-commercial educational use. The more than 250 channels set aside for education posed a challenge to institutions of higher education and offered them a new and exciting medium by which to try and achieve their educational aims.

The purpose of the dissertation was to attempt to establish the ends of higher education and their appropriate relationships to a university-operated non-commercial educational television station.

The method of the study combined scrutiny of pertinent literature, interviews, and personal experience. First, the literature of higher education and educational television was surveyed. This reading suggested the need for further study of the literature of adult and public school education and of materials closely related to television -- government documents and research studies. Discussions were carried on with university administrators and television experts, both commercial and educational, to help clarify the writer's thinking. Guidance was also obtained from the writer's personal experiences as a university instructor and as a practicing educational broadcaster over a period of several years. From these several approaches were drawn the substance and conclusions of the study.

While thirty specific conclusions were arrived at, only some of the most significant ones can be stated here. They are as follows:

1. Because of historical precedent and present social necessity, America's institutions of higher education must relate themselves directly to society by attacking social and moral issues as they arise, providing leadership in helping to solve the problems resulting from social development.

2. The development of free men in a free society is American education's fundamental task.

3. Television broadcasting is one of several feasible and effective ways in which higher education can gain its ends.

4. Because both the university and, by its very nature, television are community-centered, educational television offers opportunities for democratically shared experiences with off-campus groups.

5. The chief station administrator should act as chairman of a general television policy and programming committee composed of representatives of the board of trustees, the president, various campus interest groups, and appropriate groups from the community.

6. Station personnel need to be educators primarily, with added training in television. They should be an integral part of the academic community, with key members holding faculty rank with tenure and other faculty privileges. They should receive salaries commensurate with their faculty status.

7. Eleven purposes of general education described in the dissertation can, in general, act as guide lines for the television programs.

8. On the university campus a television station should perform at least four functions: (1) act as a training facility for students who wish to prepare for a career in television; (2) contribute significantly to furthering the ends of various other university interests and activities; (3) wherever possible, help to solve the problems resulting from expanding enrollments and teacher shortages; (4) provide opportunities for research concerned with television broadcasting.

9. Experience with television as a method of direct resident instruction indicates that it can be educationally useful both in helping to solve critical teacher and facility shortages and in supplementing regular classroom instruction.

10. Research in the educational uses of television should be in close partnership with performance. Careful research is so necessary and basic to the intelligent use of television that trained research personnel should be on the staff of the station.

243 pages. \$3.15. Mic 57-2271

RETENTION AS A FUNCTION OF MOTIVATION AND ENVIRONMENT IN EDUCATIONAL TELEVISION ON THE SECONDARY SCHOOL LEVEL

(Publication No. 21,342)

Daniel Webster Mullin, Ph.D.
University of Michigan, 1956

The purpose of this study is to determine relative measures of retention as a function of motivation and environment in educational television viewing on the secondary school level. The importance of the retention measure is based on: a) a need to discover the most effective conditions of motivation and environment for the use of television as a tool of formal education, and b) the possibility that educational television may be part of a solution to the current problems of teacher and classroom shortages.

The motivated subject competed with members of his group for an award of monetary value as determined by his learning score. The unmotivated subject was requested to complete an opinion survey pertaining to the educational television program and received an award of monetary value for his recommendations as to how the program might have been improved. The two environments treated in the study were the home and the classroom.

A 23-minute educational television program entitled "Explorations in Space" was telecast over Station WDSU-TV in New Orleans, La. This program was especially produced for purposes of the experiment. The television instructor was an astronomy professor at Tulane University who had had two years of professional television experience.

The volunteer subjects were 11th graders having a mean IQ somewhat above average. They represented the medium to high income levels according to the occupational distribution determined by the 1950 census. The students were divided into the following six groups: 1) unmotivated viewers in the home, 2) motivated viewers in the home, 3) unmotivated viewers in the classroom, 4) motivated viewers in the classroom, 5) "casual" viewers in the home, 6) non-viewers.

There were no differences between the mean IQs of the four experimental groups, 1 through 4. There was no correlation between IQ and test score in these four groups. There was a correlation between test score and IQ in group 5 at the .05 level of confidence and in group 6 at the .01 level of confidence. The subclasses of subjects were too small for a statistical analysis of interest and background in astronomy and space travel, but there appeared to be a positive correlation between sex and these two factors. There were no differences between the male means and female means within groups 1 through 4 at the .01 level of confidence.

The immediate and delayed recall tests were composed of the same fifty multiple-choice items in two test forms with different random orders of items and different random orders of the five choices for each item. The immediate recall test was administered 24 hours after the telecast. The delayed recall test was administered two weeks after the immediate recall test.

The mean test scores for the groups were found to be significantly different at the .01 level of confidence for both administrations of the test. Motivated viewing proved to be more effective than unmotivated in achieving retention at the .01 level of confidence. There appeared to be

no differences in retention due directly to differences in environment.

The following conclusions may be drawn from the study. 1) Motivation is significantly important to retention in educational television viewing. 2) There are no significant differences in retention due to differences between the home and the classroom environments. 3) The mean scores suggest that the unmotivated student may learn more in the classroom than he does at home. 4) The mean scores suggest that the motivated student may learn more at home than he does in the classroom. 5) Educational television in the home may be effective as part of the solution to the increasing shortages of teachers and classrooms. 150 pages. \$2.00. Mic 57-2272

A STUDY OF MAJOR LINCOLN DRAMAS IN RELATIONSHIP TO SELECTED LINCOLN BIOGRAPHIES

(Publication No. 21,343)

Bruce LeRoy Nary, Ph.D.
University of Michigan, 1956

The purpose of this dissertation is to study the relationship between major Lincoln dramas and Lincoln biographies as a basis for a detailed analysis of biographical dramaturgy and its use of historical data. Lincoln provides an especially good subject for such a study because of a) the number of plays which present Lincoln as a major character, b) the number of Lincoln biographies, c) the wide range of interpretations dramatists present in Lincoln plays and d) the wide range of interpretations biographers present in Lincoln biographies.

Fifteen representative Lincoln plays, published between 1862 and 1938, are included in the study. Major works of 14 biographers, as designated by Benjamin P. Thomas in Portrait for Posterity, Lincoln and His Biographers, provide the historical material. Six specific subject areas in Lincoln dramas are treated separately as chapters: Lincoln's young manhood, Ann Rutledge, Mary Todd Lincoln, Lincoln's presidential years, Lincoln quotations and Lincoln's character. Dramatizations are related to the biographical material available to the playwrights at the time they wrote their Lincoln dramas. Dramatized versions are compared with major biographical accounts of the same subject. No attempt is made to evaluate the dramas or biographies except in their use of historical material directly concerned with the Lincoln plays.

As biographers altered their fundamental approach to Lincoln biographical data, dramatists changed in their use of this material in plays. There is little similarity, however, between campaign biographies of the 1860-to-1864 period and satirical Lincoln dramas published during this period. With the appearance of eulogistic biographies, 1865 to 1875, Lincoln became a liberator and martyr. This interpretation is reflected in Lincoln dramas of the same period. A more realistic, documentary trend in Lincoln biographies and plays is evident from approximately 1875 to 1900.

During the first decade of the twentieth century, there was comparatively little interest in major Lincoln biographies or dramas. With the advent of the First World

War, Lincoln's attempts to prove that democracy was a workable form of government took on new meaning. Historians and biographers approached the voluminous Lincoln material with the technique of the scientist and academician. Detailed studies of individual episodes reflecting particular themes in Lincoln's life resulted. Lincoln became an international symbol of democracy. These trends are evident in Lincoln dramas written after the First World War and continue through the Second World War. Here the playwright's treatment of the past has specific meaning in its application to current problems. Biographers and dramatists used the Lincoln legend as an example of a forceful leader in a democracy during a national crisis.

Therefore, it is concluded that there is a direct relationship between Lincoln dramas and Lincoln biographies. Biographical playwrights, basically artists, are dependent upon biographers and historians. Biographers, fundamentally scientists, are obligated to record facts to the best of their ability. Dramatists, by the nature of their art, are entitled to dramatic license in remolding the material they obtain from biographers. This artistic transformation into the dramatic form produces varied effects which are subject to dramatists' purposes and skills. Playwrights work with complicated emotions rather than facts. It is a prerequisite of the dramatic art form that dramatists present their material in an exciting, stimulating manner. Biographical playwrights condense historical time, create dialogue, rearrange the order in which historical events occurred, or change characters and incidents from one situation to another. Material taken from actual speeches, letters or testimonies is often used under different circumstances in drama than the historical record indicates. Fictitious characters, episodes and results are created by playwrights for specific dramatic purposes.

232 pages. \$3.00. Mic 57-2273

A STUDY OF RHETORICAL INVENTION IN SELECTED ENGLISH RHETORICS, 1550-1600

(Publication No. 21,360)

Edward Merl Shafter, Jr., Ph.D.
University of Michigan, 1956

The general plan of this study involves a critical examination of those rhetorics in the vernacular printed in England during the period 1550-1600. The primary purpose of such an investigation is to clarify the kind of relationship that exists between the Tudor figures of speech and the rhetorical canon of *inventio*. Since rhetorical invention in the form of logical, emotional, and ethical proofs is seldom directly identified in the representative English rhetorics of the time, this study proposes to discover the extent to which the Tudor figures may actually represent special forms of these modes of proof. With this end in view, the Tudor figurative devices are classified, on the basis of their definition and use, according to (1) argument, (2) *pathos*, and (3) *ethos*.

The approach to the dissertation problem begins in Chapter Two with a survey of the classical, medieval, and early sixteenth-century influences upon the period of Tudor rhetoric. Chapter Three analyzes the general treatment of figurative techniques in the rhetorics of Sherry, Wilson,

Rainolde, Peacham, Fenner, Fraunce, Puttenham, Day, and Hoskins. Chapter Four categorizes those figures which pertain to the logical expansion of a subject. These figures are classified according to (1) the extrinsic topic of testimony; (2) the intrinsic topics of definition, division, subject and adjuncts, contraries, similarity, comparison, cause and effect, and antecedent and consequent; and (3) special rhetorical devices of a logical nature not included within the first two groups. Chapter Five classifies those figures linked to *pathos* under the functional headings of Anger, Contempt, Desire, Fear, Hate, Friendliness, Passion, and Pity. Chapter Six divides those figures based on ethical appeals between "objective" and "subjective" *ethos*.

The study leads to the following general conclusion. During the period 1550-1600, writers of rhetoric texts were vitally concerned with methods of amplifying a theme. This amplification of subject matter was effected, by and large, through the employment of figures of thought which operated, actually, as special forms of the modes of proof and exposition in rhetoric. Such devices, although formally classified as figures of speech and discussed under style (*elocutio*), represented definite means of producing, expanding, and supporting the content of a discourse. The figurative devices used in this capacity were derived from logical, emotional, and ethical appeals, the three-fold classical division of *inventio*. The Tudor rhetoricians did not, however, apply the term "invention" to this process of theme amplification, even though the development of the materials of discourse is properly a function of *inventio*. In general, it seems that rhetorical invention was a matter seriously attended to by rhetoricians of the time, although it was almost completely disregarded as a distinctly labeled part of the rhetorical process.

243 pages. \$3.15. Mic 57-2274

THE INFLUENCE OF SOME GROUP VALUES ON COMMUNICATIONS IN BUSINESS AND INDUSTRY

(Publication No. 21,502)

Carl Harold Weaver, Ph.D.
The Ohio State University, 1957

One of the barriers to certain kinds of communication between labor and management is the effect which the frame of reference has upon the concept evoked in members of either of these groups by a symbol used by a member of the other group. This research was an effort to quantify the barrier posed by differences in the frames of reference of these two groups in the area of industrial relations by means of the semantic differential technique developed by Osgood. Ten concepts were selected (e.g., arbitration, grievance, seniority) which were believed to encompass the area of industrial relations communication, and these were matched with 30 gradients which had heavy loadings on the evaluative factor in the factor analysis done by Osgood and Suci (e.g., fair-unfair, good-bad, white-black). Subjects marked each concept on a seven-point scale with the opposing gradient terms at each end of the scale. This 300-item pilot test was administered to 50 Ohio State University students, half of whom were labor-minded and half management-minded. From these results a 100-item pretest was constructed containing eight concepts

and 12 or 13 gradients for each concept. This pretest was administered to 67 labor leaders and 71 members of the management group. The split-half reliability coefficients were .96 for labor and .98 for management. From these results a 25-item test was constructed with split-half reliability coefficients of .95 for labor and .92 for management. The standard error of measurement for this test was approximately one-tenth of a scale unit.

The mean response of the labor group on the pretest was 2.3; of management, 4.6. The mean response of management fell on labor's end of the continuum for the concepts seniority and arbitration, and was approximately neutral on grievance. The scale distance from the neutral point on the scale (4.0) to the mean of the group responses (Osgood's D value) was 1.5 or more on 85 of labor's items but reached that value on only 22 of management's items. The most extreme mean response for any labor subject was 1.0, followed closely by others almost as extreme. The most extreme mean response for any management subject was 5.78, and there were only 13 management subjects whose mean responses exceeded 5.0. In addition, members of the management group agreed with each other less well than members of the labor group did. The mean

standard deviation on individual items was greater for management than for labor, and the difference was significant at the 5 per cent level of confidence. Finally, 97 of the 100 items differentiated between the two groups at the .1 per cent level of confidence or better.

The following conclusions were drawn:

1. The frames of reference of these two groups can be measured with the semantic differential and the strength of the semantic barrier quantified.
2. There were significant semantic differences between these groups. The concepts evoked by these symbols are probably not always the ones intended.
3. The labor group stereotyped more than the management group, and the stereotypes were more extreme. The semantic distance between the two groups seemed to result more from the position of labor than from the position of management.
4. Management seemed to be leaving its traditional position on some of these concepts and adopting some of the concepts of labor.
5. Management's frame of reference in this area was not well understood either by management or by writers on the subject.

145 pages. \$2.00. Mic 57-2275

ZOOLOGY

RADIANT ENERGY, WITH PARTICULAR REFERENCE TO THE REGION 365 mμ TO 730 mμ, IN RELATION TO THE BEHAVIOR, EYE PIGMENTS, AND CORNEA OF STOMOXYS CALCITRANS (LINNE)

(Publication No. 18,455)

Ralph Campbell Ballard, Ph.D.
Rutgers University, 1956

A study was made of the response of Stomoxys calcitrans to radiant energy. It was divided into four parts: the behavior of male and female S. calcitrans to two intensities of light in the region 365 mμ. to 730 mμ.; the absorption spectrum of the eye pigments of male and female S. calcitrans; the absorption spectrum of the cornea of male and female S. calcitrans; and analysis of adult flies for vitamin A.

In the work with the response of Stomoxys to light, the intensities of the various wave lengths were equated by means of a calibrated photocell. The absorption spectra were obtained by means of the Beckman spectrophotometer and the Cary recording spectrophotometer.

A difference in the behavior towards light was found between male and female flies as well as in the absorption spectrum of the eye pigment. The male and female Stomoxys calcitrans produced three peaks of response at the lower intensity: 365 mμ., 465 mμ., and 640 mμ. At the higher intensity, however, the male evidenced four response peaks (390 mμ., 440 mμ., 515 mμ., and 640 mμ.) whereas the female response gradually decreased from 365 mμ. to 575 mμ. and peaked again at 640 mμ.

The experiments with the absorption spectra of the eye pigments lend support to the hypothesis that these pigments

serve to absorb light entering the ommatidium obliquely, thereby aiding in localizing the image of the orienting light on the retinal cells. If the above hypothesis is true, both sexes evidenced a greater orienting ability to light in the violet and ultraviolet regions; this was more pronounced in the male than in the female.

The cornea showed virtually a straight line absorption in the region 345 mμ. to 750 mμ. and therefore did not influence the qualitative response of Stomoxys to light in this area. There was an absorption peak in the ultraviolet at 280 mμ., 240 mμ., or 295 mμ., depending upon the specimen of S. calcitrans.

In an analysis where the lower limits of sensitivity were 1×10^{-6} milligrams per fly, no vitamin A was found.

134 pages. \$2.00. Mic 57-2276

A STUDY OF THE PLANKTONIC ROTIFERS OF THE OCQUEOC RIVER SYSTEM, PRESQUE ISLE COUNTY, MICHIGAN

(Publication No. 21,143)

Neil William Beach, Ph.D.
University of Michigan, 1956

The objectives of this study were: (1) determination of the identity of any planktonic rotifers occurring anywhere within the Ocqueoc River system; (2) comparison of the qualitative and quantitative aspects of the separate rotifer faunas in each of the discrete lotic and lentic habitats of the system; (3) analysis of the differential effects

of stream and impoundment conditions, natural or otherwise, on both autochthonous and allochthonous rotiferan faunas; and (4) determination of those factors, whether physical, chemical, biological or any combination thereof, which in any significant degree might be responsible for the development and maintenance of any autochthonous rotiferan fauna anywhere in the system.

Field work included collecting and preserving a total of 534 plankton samples. Live samples were also taken for more accurate identification of the organisms. Collections were made in all seasons of the year, but mostly in the summer, and taken at 42 field stations, of which 23 were located in the river proper and the remainder in lakes. Most of the preserved samples were quantitative in nature and usually from surface waters. They were obtained by straining a given volume of water, collected with a Kemmerer water sampler, through a Wisconsin plankton net equipped with No. 25 silk bolting cloth. Duplicate samples were taken at each station. Selected physico-chemical data were obtained at the same time the plankton was collected. The samples were examined microscopically and all rotifers contained in an entire Sedgwick-Rafter counting chamber were enumerated. Two chamberfuls were counted for each sample bottle and final calculations of the population at any given station are based on an average of two such duplicate counts.

Twenty-four genera containing thirty-four species of rotifers were identified in the plankton, most of which have also been reported from other lakes and rivers. Lakes and artificial impoundments were the major locations of plankton production in the system and supplied the river with its "limnetic" rotifers. Lotic situations did not possess a planktonic rotifer fauna distinct from lakes and any rotifers collected in the river were also collected in lakes. As the water flowed downstream from a lake, the plankton decreased and eventually disappeared if the length of the stream segment was great enough. Additional factors effecting a decrease were current, depth of water, turbulence, and amount of vegetation, or other objects, in the channel which supported a periphyton assemblage. The periphyton acted as a filter and strained the organisms from the flowing water. As a result, little plankton from one lake was transported to another. The rotifer fauna varied somewhat from lake to lake but such variation was more quantitative than qualitative in nature. Males of *Keratella cochlearis* were found in one lake in all summer collections and their presence shown to be related to abundance and quality of food material and to conditions of crowding rather than to temperature. Males were also obtained in autumn samples from other lakes. Considerable numbers of *Limnias ceratophylli* were collected in the open water of a few lakes although this species is usually considered to be sessile.

It is concluded from this study that the Ocqueoc River system does not differ significantly in the quality of its planktonic rotifer fauna but rather in the quantity and proportion of its abundant forms. The system is classed as a *Keratella-Polyarthra-Synchaeta* complex and *Keratella cochlearis* is the dominant species, both in abundance and distribution.

156 pages. \$2.05. Mic 57-2277

A STUDY OF HYDRAS IN LAKE ERIE: CONTRIBUTION TOWARD A NATURAL HISTORY OF THE GREAT LAKES HYDRIDAE

(Publication No. 21,426)

Louis Burrell Carrick, Ph.D.
The Ohio State University, 1956

The monograph presents the results of an ecological investigation of the hydras and their associates conducted at the Franz Theodore Stone Laboratory, Put-in-Bay, 1951-1954. The findings, accumulated from year-round field work and collateral experimentation, are discussed in the light of our knowledge of the Hydridae.

Definitive determinations of the species of *Hydra* inhabiting western Lake Erie were made by examination of sexual individuals, clone culturing, and nematocyst analysis. Ewer's suppression of the genus *Pelmatohydra* P. Schulze, 1917 has been accepted; the local species are listed accordingly: *Hydra oligactis* Pallas, 1766; *Hydra pseudoligactis* (Hyman, 1931); *Hydra americana* Hyman, 1929; *Hydra littoralis* Hyman, 1931. *Chlorohydra viridissima* (Pallas, 1776) and *Hydra carnea* L. Agassiz, 1850 were not found in the lake but were identified from specimens obtained at Pelee Island.

One other coelenterate was also found in Lake Erie — *Craspedacusta sowerbii* Lankester. The hydroid stage of the fresh-water jellyfish has established itself in the shoal areas at South Bass Island, but the medusoid stage has not yet been seen.

The above species records — *H. oligactis* and *C. viridissima* excepted — are new records for the Great Lakes.

Evidence indicates that the distribution of hydra populations in Lake Erie and the other Great Lakes is limited to the plant and rock substrata of the littoral zone.

In the Island Region, the predominant species is the swift-water hydra, *H. littoralis*, whose ecology has not previously been studied. Its niche in the "Aufwuchs" community of the limestone rubble is described. The microcommunity is dominated by *Hydra*, *Plumatella*, *Vorticella*, and *Cymbella*, which grow on the rock substratum where typical associations of swift-water arthropods maintain position.

The interactions between the species in the microcommunity were followed in Fishery Bay at South Bass Island by study of living material obtained with a slide-rack and stone-anchor collecting rig.

The principal prey of the hydras is *Chironomus* larvae rather than planktonic copepods and daphnids. Its enemies are few. The only predator of hydra appears to be *Microstomum*, which appropriates its stenoteles.

The hydra is parasitized by *Anchistropus minor* Birge, 1893, and *Hydramoeba hydroxena* (Entz, 1912). The surface of the hydra provides a microhabitat for the ciliate ectocommensals, *Trichodina pediculus* and *Kerona polyporum*.

The amoeba may be pathogenic, but the parasitic mode of existence of the chydorid cladoceran on the hydra does not appear to seriously injure the host. The association of the cladoceran and the hydra — hitherto unstudied in natural populations — is analyzed.

The shell of *Goniobasis livescens* provides another microhabitat for *H. littoralis* and other microbiota. The relationship between the snail and the hydra is phoretic; the snail serves as an agent in the distribution of the hydras.

Abiotic habitat factors are optimal for hydra in western Lake Erie. Temperature appears to be the factor of environmental resistance which limits the high reproductive potential of the asexually reproducing hydras. This is reflected in the annual cycle, which is delineated from data on time-relative density of the hydra population in the study area of Fishery Bay. The sexual periods of the local species of *Hydra* occur in autumn. Detailed observations on this phase of hydra's life history are presented, and evidence pertaining to gonad induction is critically reviewed.

Hydra's role in human ecology is examined. It was shown by experiments that *H. littoralis* and *H. oligactis* kill the newly hatched fry of commercially valuable fishes; e.g., Erie whitefish, pickerel, and pike. To what extent hydras destroy larval fishes in the habitat or compete with them for food could not be demonstrated. Whether the tremendous aggregations observed on the nets cause injury to the skin of fishermen was beyond the scope of the investigation. 326 pages. \$4.20. Mic 57-2278

THE PHYLOGENETIC RELATIONSHIPS AND
ZOOGEOGRAPHY OF THE SNAKES OF THE
GENUS *LEPTODEIRA*

(Publication No. 21,173)

William Edward Duellman, Ph.D.
University of Michigan, 1956

The purpose of this study is to analyze the various populations of the Neotropical snakes of the genus *Leptodeira* and to determine the inter- and intraspecific variation and the affinities of the component species.

Twenty-four hundred specimens, 75 of which were seen alive, of the genus *Leptodeira* were studied. Characters of the scutellation, coloration, dentition, and hemipenis were examined. These data were tabulated and analyzed statistically; frequency distributions for the characters in the various populations were made. Locality records were plotted on distribution maps. The clinal variation was correlated with certain environmental factors.

It was found that many populations of these snakes that were formerly regarded as distinct species gradually merge into adjacent populations or intergrade with allopatric forms in a more or less restricted area. Consequently, where former workers have recognized as many as 17 species embracing 22 forms, only 7 species with 19 forms, one of which is an undescribed subspecies, are recognized here. Two species have a wide geographical distribution from Mexico to northern or central South America. Within their ranges both species come in contact with environments ranging from semi-arid scrub forest to tropical rainforest. Parallel evolution in the two species has produced in the rainforest habitats arboreal forms with laterally compressed bodies and enlarged vertebral and paravertebral scale rows. The other populations in both species are terrestrial.

In many forms there is a close correlation between the morphological characters and the environment. This is best shown in two species in which the regression between the number of ventral scutes and the degree north latitude is an especially close fit. In one of the species that has a

trend toward fewer body blotches to the north there appears to be a similar trend in altitudinal variation; those specimens from the higher elevations approach the conditions found in individuals from the more northern latitudes.

Leptodeira apparently arose from a rather generalized colubrid stock between the end of the Paleocene and mid-Pliocene in Central America, where it underwent differentiation and dispersal northward. After the closure of the Panamanian Portal in late Pliocene two species entered South America, both of which also live in Central America and Mexico. The closest relatives of *Leptodeira* are *Hypsiglena* and *Pseudoleptodeira*, both of which may have been derived from an early *Leptodeira* stock through progressive loss of the grooves in the posterior maxillary teeth and through the reduction in the number of scale rows. It seems that *Leptodeira* may have arisen from an ancestor also common to *Trimorphodon*. These two genera are not closely related, and there are no living intermediate forms as there are between *Leptodeira* and *Hypsiglena* and *Pseudoleptodeira*. 310 pages. \$4.00. Mic 57-2279

ASPECTS OF THE BIOLOGY OF *POMATIOPSIS*
LAPIDARIA (SAY) (MOLLUSCA: GASTROPODA:
PROSOBRANCHIA)

(Publication No. 21,174)

Dolores Darlene Saunders Dundee, Ph.D.
University of Michigan, 1956

The snail, *Pomatiopsis lapidaria*, has been shown to be potential host for *Schistosoma japonicum*, the human blood fluke, which, in the Orient, produces a widespread human disease, schistosomiasis. It is unlikely that this disease might ever become established in the United States, but in the event that it should, available information concerning the distribution, habits, habitats, and morphology of *Pomatiopsis* would be essential for control or elimination of such a disease.

The range of *P. lapidaria* includes most of the eastern half of the United States and the southern portion of Ontario. This snail is generally an inhabitant of floodplains or marshy areas. A comparison of the habitats of *Pomatiopsis* and *Oncomelania*, the intermediate host of *Schistosoma japonicum* in the Orient, indicates that they have many similarities. However, *P. lapidaria* seems to be better adapted to terrestrial conditions than any of the *Oncomelania*s. Likewise, *P. cincinnatiensis*, a closely related species also found in much of the eastern portion of the United States, seems to be more closely associated with somewhat drier conditions than does *P. lapidaria*. This progressive adaptation to life on land is indicated also by (1) the decrease in the number of gill filaments from *Oncomelania* to *P. lapidaria* to *P. cincinnatiensis* (2) the increase in the size of the pedal gland in the same sequence (3) the nature of the habitat (4) the amount of time spent submerged. *P. lapidaria* seems to be more closely related to the Japanese species, *Oncomelania nosophora*, than to any other *Oncomelania*.

Pomatiopsis lapidaria is dioecious and exhibits sexual dimorphism in size, shape, and average number of whorls. The sex ratio of field-collected material averaged 2.9 females to 1 male; among laboratory hatched specimens it was 2.3 to 1.

Two stations near Ann Arbor, Michigan were used for making bimonthly observations on the habits of *P. lapidaria*. At these stations the snails were dormant during the cold months (late October through early March) when they were found lying under fallen vegetation, in crevices, or beneath objects, pulled far back into their shells with their apertures closed by the operculum. With the advent of warmer weather (daytime highs between 50 and 60°F) in the spring, the snails became active. Mating, which took place at any hour and apparently anywhere on the soil within the habitat, occurred from mid-March through early July. Eggs were laid singly, coated with a husk made of soil, and often buried just beneath the surface of constantly moist soil. Incubation time in the laboratory was 5-7 weeks at a temperature of 60°F. It is doubtless shorter in nature although this was not determined. The size of newly hatched individuals was approximately 0.5 mm wide and 0.5 mm long; they usually had 2.25 whorls. Growth rate was approximately 0.1+ mm per week in the laboratory and 0.19 to 0.20 mm per week in nature. The largest number of eggs laid by any female under observation was 42. From the last of July until the last week of August the snails were inactive again, except for rainy periods. Mating and some egg laying occurred from late August through the last of October when the snails once again became dormant.

An account of the morphology of *Pomatiopsis lapidaria*, including descriptions and drawings of the topographic anatomy, the digestive and nervous systems, male and female reproductive systems, heart, kidney, and sense organs, is given. Also included are histological descriptions and sketches. Comparisons of anatomical details of *Pomatiopsis lapidaria* with those of *P. cincinnatiensis* and some of the *Oncomelania* are presented.

97 pages. \$2.00. Mic 57-2280

STUDIES ON THE SEDIMENTABILITY AND BIOCHEMICAL CHARACTERISTICS OF PENTOSE NUCLEIC ACID COMPLEXES IN THE EMBRYONIC AND ADULT SEA URCHIN

(Publication No. 21,202)

Kathryn Marcella Eschenberg, Ph.D.
University of Washington, 1957

A study was undertaken to determine whether the behavior of pentose nucleic acid complexes in response to centrifugation bears a relationship to developmental changes in the sea urchin, *Strongylocentrotus purpuratus* (stimpson). The investigation included eggs, embryonic stages up to the pluteus, and one adult differentiated tissue, the small intestine.

Cytochemical studies showed that PNA was diffusely and uniformly distributed throughout the unfertilized egg and became concentrated in the light half of eggs stratified by centrifugation. The major tissue component of the small intestine is the epithelium, in which PNA appeared to be uniformly dispersed throughout the ground substance.

Analyses of PNA content of eggs and embryos revealed that small but perhaps significant variations could be correlated with morphogenetic changes. There is no gross change in the amount of PNA per embryo during pre-larval development.

Homogenates freed of microscopic cell components by low speed centrifugation and then subjected to an ultracentrifugal force (105,400 x g) for periods of time up to 4 1/2 hours were found to contain PNA in sedimentable complexes that varied with the developmental stage and with the centrifugation medium employed. In an isotonic KCl-citrate medium the pattern of sedimentation of PNA complexes from eggs and from embryos was the same, approximately 90% of the submicroscopic PNA having been sedimented at 4 1/2 hours. The small intestine differed markedly from embryonic stages in that a maximum of only 35% of the submicroscopic PNA could be sedimented within the same time interval. Even lower values were obtained from the intestine of starved animals. With assumptions as to the shape and density, it was calculated that the minimal size of these complexes sedimented in KCl-citrate was 16 mμ (diameter). No information was obtained as to the morphological homogeneity of the sedimentable PNA.

Radioactive phosphate was incorporated into both the sedimentable and the non-sedimentable submicroscopic PNA fractions in 57 hour embryos. The PNA which was sedimented between 1 1/4 and 4 1/2 hours of centrifugation had a constant specific activity, indicating that this fraction was homogeneous with respect to P³² turnover. The relatively small amount of non-sedimentable PNA had a specific activity about four times greater than that of the sedimentable PNA.

The sedimentation of PNA in a hypotonic sucrose solution (0.6 M) was more rapid, but not necessarily more complete, than that in the ionic medium in all cases. Maximum sedimentation was approached within three hours. The minimal size of the complexes sedimented under these conditions was calculated to be 42.5 mμ. The maximum amount of PNA sedimented amounted to approximately 95% of the total submicroscopic PNA in the unfertilized egg, dropped to 59% of that in the 83 hour embryo, and increased to 81-88% of that in the adult gut. The sedimentation curves indicated that at all stages the degree of dispersity in the sedimentable PNA complexes was the same.

These findings are considered in relation to current concepts of the submicroscopic morphology of the cell. Specifically, it was suggested that PNA-rich complexes varied both in the degree of their association with the endoplasmic reticulum and in their stability in different media.

Chemical studies of PNA from homogenates and from centrifuged fractions of different developmental stages revealed that the phosphorus content bore a constant quantitative relationship to the nitrogen base content.

Pentose-to-nitrogen base ratios of PNA from adult small intestine suggested a purine-to-pyrimidine ratio of about unity, but these ratios in PNA from homogenates of eggs and embryos were unusually high. Fractionation of egg homogenates indicated the presence of at least two types of PNA complexes, the more sedimentable (in KCl-citrate) fraction being responsible for the high pentose-to-nitrogen base ratio. This fraction was absent or the amount was greatly reduced in the small intestine.

136 pages. \$2.00. Mic 57-2281

PROPAGATION OF BAIT FISHES IN NEW YORK FARM PONDS

(Publication No. 21,081)

John Latimer Forney, Ph.D.
Cornell University, 1957

Bait fish were stocked in 72 farm ponds located in central New York State during 1953-54. Seven species were tested individually in one or more ponds. Three species, the golden shiner, white sucker and fathead minnow, are recommended for propagation in New York ponds.

Adult golden shiners were stocked in ponds at rates of 200 to 1,800 per acre. Population estimates during the second growing season demonstrated that the number of golden shiners present was governed more by physical and biological environment than by stocking rate. The weight of the standing crop in 11 ponds at the end of the first growing season averaged 167 pounds per acre compared to 375 pounds per acre in August of the second growing season.

Suckers were stocked as advanced fry in 13 ponds at rates of 50,000 to 231,000 per acre. Survival of fry to fall ranged from 1 to 71 per cent and averaged 21 per cent. The rate of growth in fertilized ponds was negatively correlated with the population density. The yield during the first growing season averaged 265 pounds per acre. In six ponds where young were overwintered, the mean length increment was 0.72 inches and the population weight increased 92 pounds per acre.

Adult fathead minnows were stocked in 8 fertilized ponds at rates of 600 to 2,000 per acre. A relatively small proportion of the first year's hatch of young reached saleable size of 1.8 inches by fall, and the average yield from eight ponds was 12,140 per acre. These ponds yielded 31,000 to 62,000 saleable-size fatheads per acre during the second growing season.

Methods are described for managing New York bait fish ponds. 214 pages. \$2.80. Mic 57-2282

A MORPHOMETRIC ANALYSIS OF ALLOMETRY IN SHELLS OF THE TURTLES: GRAPTEMYS GEOGRAPHICA, CHRYSEMYS PICTA, AND STERNOTHERUS ODORATUS

(Publication No. 21,341)

James Emile Mosimann, Ph.D.
University of Michigan, 1956

Samples of three species of turtles were collected, each from a single lake. The variation found in each sample is considered to be indicative of that which can occur in a single population of each species.

Measurements were made of: (a) width, height, and length of the shell; (b) shell volume and cross-section; and (c) weight of the whole animal. In each sample size ranged from that of hatchlings to that of large adults.

Very high correlations were found between the measurements taken, when related to each other, either as logs (expressing the relation $y = ax^b$) or as linear measures (expressing the relation $y = bx + a$). The use of the term allometry was discussed and it was proposed that this term be used for differential changes as demonstrated

from either $y = bx + a$ or $y = ax^b$. Expected volume relations to those of linear measures in rectangular solids were derived (Appendix A). The relation as predicted from $y = ax^b$ was used in this study. A method was proposed for testing the adequacy of observed proportional changes in length, width, and height in description of all the differential changes important in determining total size. Since correlations are very high, it is believed that the pattern of proportional changes in individuals with increase in size follows closely that for the population.

Length increases proportionally faster than width or height. Width and height show varying proportional changes with respect to each other for a given species and sex. By comparison with the cube root of volume, length increases at a faster rate, width and height more slowly, except in females of *Chrysemys* where height and cube root of volume show the same rates. Estimates of proportional change in carapace dimensions based on volume relations are very consistent with those based on the relations of the dimensions themselves.

This differential growth makes difficult the use of simple ratios of length, width, and height in taxonomic analysis. However, the populations studied are remarkably invariable once variability due to ontogenetic change is "eliminated".

Volume and weight (measured under controlled conditions) do not change relative to each other, except slightly in *Chrysemys*. Relations of volume to length and weight to length are very consistent with each other. Volume and weight are highly correlated.

A mathematical model was derived which gives the expected patterns of changes of a rectangular solid defined by the width, length, and height relations of the turtles. This model gives the successive volumes of such a solid in which the sides have the same differential growth rates as the length to width to height relations of the turtles.

On the average, the volume of *Chrysemys* and *Graptemys* is a constant percentage of the volume of the solid defined above. For these turtles, the linear relations described above are adequate descriptions of average differential change in form. Cross-sections taken in conjunction with interpretations from the models indicate a probable significant bilateral increase in diagonal directions in *Sternotherus*.

On a descriptive basis, regressions of the logarithms rather than those of the original data are thought to be more useful in this report. The high correlations between the measures taken indicate these animals as excellent ones for the study of relative growth. Many relations could not be clearly demonstrated were the correlations lower.

162 pages. \$2.15. Mic 57-2283

THE EFFECTS OF GAMMA RAYS ON STAGES OF ENTAMOEBA HISTOLYTICA

(Publication No. 21,357)

Curt Richard Schneider, Ph.D.
University of Michigan, 1956

The object of these studies was threefold: (1) to measure the effect of gamma rays on the rate of division of *Entamoeba histolytica*, (2) to record evidence of genetic

changes attributable to gamma radiation and (3) to compare the lethal dose of radiation for the trophozoite and for the cystic stage. Because of the paucity of standardized methods for experimenting with the entozoic amebae, information about their response to radiation has been lacking. A portion of this study was devoted to developing methods of measuring the physiological response of amebae, based on the requirements for *in vitro* culture of the organisms.

Strains UC and NRS amebae were grown in biphasic egg slant tubes with Stone's Locke overlay. For experiments with trophozoites, pools of amebae were washed and suspensions of known numbers of organisms prepared. Exposures were performed using the large Cobalt-60 source in the Fission Products Laboratory at the University of Michigan. Suspensions were contained in Lusteroid tubes during irradiation. Control suspensions were exposed to the conditions of the radiation cave, but were shielded from the source by a concrete wall. Irradiated suspensions were introduced into egg tubes preconditioned with homologous bacteria. Tubes of UC strain amebae were examined for growth at intervals, until motile trophozoites could be discovered. This was arbitrarily defined as ending the lag phase of growth. Increase in lag phase was compared with the lag phase displayed by controls, and interpreted to reflect death of organisms due to gamma radiation. Following irradiation of NRS strain cysts, serial decimal dilutions of test and control suspensions were made and five tubes inoculated with each suspension. The Most Probable Number calculation was employed (Chang and Baxter, 1955, *Am. J. Hyg.*, 61:121) to ascertain the percentage of control cyst and test cyst survival.

A noticeable increase in lag phase began following exposure to about 100,000 roentgens equivalent physical. A dose of 200,000 rep or more resulted in death as indicated by failure of the cultures to grow. The relation between increasing lag phase and increasing doses of radiation is represented by a logarithmic straight line. Radiation did not cause a change in size of amebae or in their capacity for absorbing eosin. Recovery of the normal lag phase was shown in the progeny of irradiated trophozoites.

A dose of about 10,000 rep noticeably lowered the number of viable cysts in a suspension. A dose of about 18,000 rep destroyed almost 99% of viable cysts. The relation between increasing cyst mortality and increasing doses of gamma rays is represented by a logarithmic straight line. The relative age of cysts and the relative turbidity of the suspending medium did not influence the rate of cyst inactivation.

It was concluded that (1) measuring the lag phase was a useful but only approximative device for determining the effect of gamma rays on trophozoites, (2) the Most Probable Number calculation was less approximative in determining the effect of gamma rays on cysts, (3) the inactivation of trophozoites and cysts by gamma rays is a reaction of the first order, (4) no evidence of genetic changes in trophozoites was found, and (5) data are presented which suggest that cysts are roughly one-tenth as resistant to gamma rays as trophozoites. The implications of the last conclusion are discussed. 117 pages. \$2.00. Mic 57-2284

OBSERVATIONS ON THE RENESTING BEHAVIOR OF THE RING-NECKED PHEASANT

(Publication No. 21,457)

John Lyman Seubert, Ph.D.
The Ohio State University, 1956

In recognition of the lack of accurate information about renesting by the ring-necked pheasant (*Phasianus colchicus torquatus*), an intensive study on the renesting behavior of semiconfined pheasant populations was conducted in central Ohio during 1950 and 1951.

A fenced research area of 7.85 acres was established in a field of first year mixed hay; portions of the cover within the area were killed, and alternate 16-foot strips of cover and bare ground were maintained; brailed, individually marked yearling game-farm birds were released into the area in the spring (12 cocks and 59 hens in 1950, and 15 cocks and 120 hens in 1951); observations of breeding and nesting behavior were made; nests and nesting hens were located by periodic searching of the cover strips; embryos were aged, and nests were randomly assigned to categories of incubation; and nesting hens were disrupted from nests at various stages of incubation.

The breeding behavior observed during the study was similar to that reported for wild populations, regardless of the fact that birds were brailed and confined and cover conditions were probably atypical.

During both years of the study, many hens established second nests, and a few nested for a third time; no fourth nests were observed. Of the hens disrupted from or deserting initial nests, 36 per cent in 1950 and 67 per cent in 1951 established second nests. Of the hens disrupted from or deserting second nests, 13 per cent in 1950 and 14 per cent in 1951 established third nests.

The clutch size of initial nests was significantly greater than that of second nests; however, initial nests could not be distinguished from renests on this basis. The fertility of eggs in second nests was lower than in initial nests.

When data from both years were combined and analyzed statistically, more hens whose nests were disrupted early in incubation renested than did hens whose nests were disrupted later in incubation. No such correlation was found when the data for each year were analyzed separately. It was also determined by statistical analysis of the combined data that the stage of incubation at the time hens were disrupted affected the length of the renesting interval, i.e., the longer clutches were incubated before disruption, the longer the intervals. For the two seasons tested separately, no such correlation was found. Regardless of the stage of incubation at which hens were disrupted, they rarely renested unless disruption occurred early enough in a season, and the degree of renesting decreased as the season progressed.

A hypothetical example is presented to show how potential pheasant production may be affected by renesting and by the chronology of hatching when disruption (by catastrophe) occurs at various times throughout the nesting season. It was concluded that successful reproduction can be realized if nest disruption occurs early enough in a season for a maximum of renesting to occur or late enough so that a major portion of the initial nests has already hatched. The example is discussed in relation to studies of wild pheasant populations and, though theoretical, gives

a plausible explanation of the nesting behavior and final productivity observed by other investigators.

Double peaked nest establishment and hatching curves were found to be an indication of renesting activity. Other investigators probably have often been correct in their interpretations of secondary peaks as representing renesting activity.

If the nesting behavior observed in this study is typical of wild populations also, cognizance of the effect of hatching chronology and of the relationship between the time of season and renesting potential will make possible a better evaluation of over-all seasonal pheasant production.

137 pages. \$2.00. Mic 57-2285

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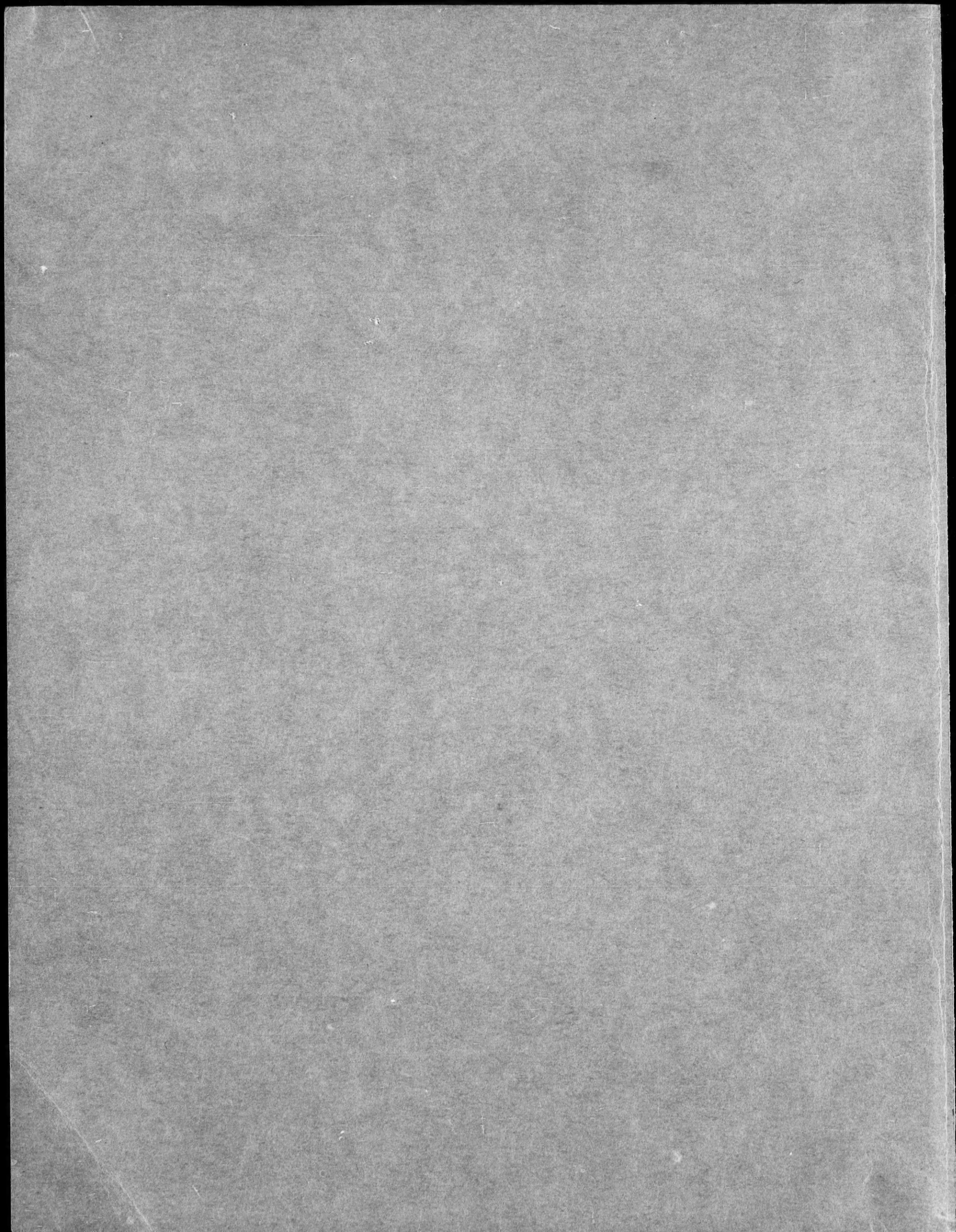
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